ELECTRICAL REVIEW

[ILLUSTRATED]

A WEEKLY JOURNAL OF

ELECTRIC LIGHT, TELEPHONE TELEGRAPH AND SCIENTIFIC PROGRESS.

(Formerly Review of Telegraph and Telephone.)

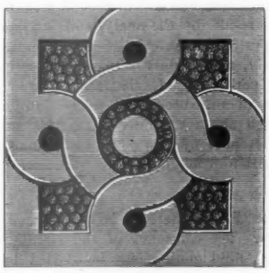
Vol. 4, No. 23. WEEKLY. | NEW YORK, SATURDAY, AUGUST 9, 1884. | $3 per annum. Single Copies, 10 Cents.

Copyright, 1883, by DELANO & COMPANY, 23 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

Western Electric Specialties.

Electric bells and annunciators are now so well established in the favorable estimation of the public that it is hardly necessary to enlarge upon their superiority to the mechanical system of cranks and movable wires. When it is considered that in the mechanical system the entire wire from the handle to the bell must move; that the tendency of every movement is to stretch the wire; that the wire must be kept tight the entire length; that changes of temperature alone in long stretches are sufficient to throw a bell into disorder; that repairs involve moving of carpets and breaking of plastered walls—in view of these disadvantages, the simple fact that in the electric system the connecting wires do not move at all is sufficient to secure for it the preference. The electric wires require no cranks, and can turn any angle either acute or obtuse, or any curve, without interfering with their efficiency. The muscular exertion to close an electric circuit is so slight, in comparison with that required to ring a mechanical bell, that this consideration alone becomes an important one in favor of the electric system.



SQUARE BRONZE.

It only requires a suitable battery as a source of electricity, and insulated copper wires, properly laid and protected, to convey the current, with the instruments hereinafter described, to constitute a system free from all these objections, and without any counterbalancing defects of its own.

The electric system of bells and annunciators was first appreciated and successfully introduced in France and in Switzerland. For some years after it had become established in those countries the attempts which were made to transplant the system to the United States met with only moderate success. In some cases the French instruments were imported, in others they were copied, but for various reasons the public failed to gain confidence in this class of electrical apparatus, and it was not extensively used.

The successive steps in improvement which have culminated in the needle annunciator are indicated by the number of patents of different dates which relate to the various details, as well as to the fundamental principles of the instrument. The needle annunciator possesses some important merits which are lacking in other instruments for the purpose, whether of foreign or domestic manufacture.

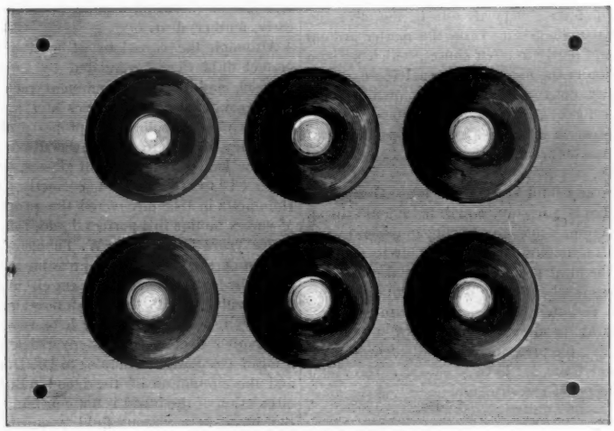
In respect to nimbleness, and certainty of action, elegance and durability, the needle instrument is much superior to any other. The different parts of the instrument are made in large quantities, and of the best materials and workmanship. The large product of the Western Electric shop in this department enables the company to place the prices at a moderate limit. That the popularity of its instruments is on the increase is evidenced by the extensive and growing demand which still exists, and which is not confined to any part of the continent.

Next in importance to the annunciator itself, and, in fact, scarcely second to it in importance, is the character of the electric bell which is used in a system of electric calls or alarms. On the bell comes the greatest strain, and when it fails the system is practically inoperative. The company spares no expense to make electric bells durable and reliable, and attributes to their superiority much of the success that has attended the use of their apparatus. They manufacture them in two forms—the wooden box and the skeleton. The skeleton bell is used for the larger and the box bell for the smaller sizes of gongs. The external brass parts of both forms are nickel-plated.

In many cases the sound of a bell is found to be louder than is desirable. To meet this objection there is an electric buzzer, an instrument in which its vibrating hammer strikes a sounding piece, producing a distinct humming or buzzing sound. It is often used to call a clerk or a messenger from his desk without directing general attention to the call. When an especially loud call is required, as in large halls, at railroad crossings, and for fire alarm purposes, the turtle gong or our electrical mechanical bell is used. The former, the name of which is suggested by its appearance, is a large gong, which entirely covers the electrical working parts. It is capable of finer adjustment, is more simple, and gets more power in the stroke of the hammer than any other large gong which works entirely by electricity. The electro-mechanical bell is very carefully made, and is intended for use where a single loud stroke, or a succession of them, is required.

TURTLE GONG.

MIDGET CALL BUTTONS.



COMPOUND BRASS CALL BUTTONS.

As the value of electrical apparatus is entirely dependent upon absolute certainty of action, it is of the highest importance that it be perfect in every part. If a call bell sometimes rings when you press the button and sometimes not; if a burglar alarm goes off at the wrong time and fails to go off at the right time—such an apparatus is worse than useless. If it is worth while to have electrical apparatus at all, it is worth while to have it made of the best materials and in the best way, and to have it set up and put in operation by the best-skilled workmen in the most thorough and scientific manner known.

The connecting wire used is made from Lake Superior copper, and is of the highest conductivity and of proper size. It is perfectly insulated and finely polished.

The fact that an hotel, residence or other building is handsomely finished and occupied is no serious obstacle in the way of its being furnished with an electric system of calls. Workmen are trained to do this work without disturbance to the regular occupants of the rooms, and without leaving a mark or a scratch on the wood-work or a wire visible.

The accompanying diagrams show two electric bells and two push buttons, in connection with one battery for call and responses in ordinary office or home call-bell system. 1, 1, push buttons. 2, 2, bells. *B*, battery.

The method of communication at a distance by means of a single wire and a ground on an open circuit system, is shown below. In this system two separate batteries are employed, one at each end of the line, which are always open, and only in operation at the moment of signalizing. For this system, bells having the resistance of at least twenty ohms are used. The number of cells required for each battery will be according to the distance of the stations from each other. For less than one mile, six cells at each end will be sufficient battery. In the diagram, 1 is a double contact key; 2 is the bell; *B* is the battery, and *G* is the ground connection at each station, respectively. The white lines will show at a glance the method of connecting up the system.

THERMOSTAT.

The Electro-Mercurial Fire Alarm, as perfected by the Western Electric Company, is very simple in its design and operation. It consists:

1st. Of mercurial bulbs, or thermostats, placed in the ceilings throughout the building.

2d. Of insulated copper wire, running through the thermostats to the office of the building, and forming with the battery an electric circuit.

3d. An electric annunciator and bell placed in the circuit at the office.

When the atmosphere around any thermostat in the building is overheated, the electric circuit is completed at that point, the bell rings to draw attention to the fire, and the annunciator shows where it is.

The thermostat used, and which is shown in principle by the accompanying cut, is simply a glass bulb in which a column of mercury moves up and down with the rise and fall of the temperature, with a platinum wire sealed in the glass at each end, the lower wire in contact with the mercury, the

upper one terminating just above its surface. This simple bulb, connected in an ordinary electric circuit, is the best possible detective of fire. It is set in the ceiling of a room, and whenever the heat becomes too great for safety the mercury rises, thus completing the circuit and ringing the alarm gong.

The thermostats are inclosed in copper shields and placed in the ceilings, one in every room or closet, in hotels, office buildings and dwelling houses. In all large rooms, such as stores, warehouses and manufacturing establishments, one is placed in every twenty feet, so that in no case can the heat spread over ten feet before its effect will be felt. The thermostats are generally set at 120° Fahrenheit, but in places where the normal temperature is frequently high, as in engine rooms, laundries, attics, etc., they are set at a higher temperature.

The Electro-Mercurial Fire Alarm is especially useful in stores, warehouses and manufacturing establishments, in mills and elevators, in schools, colleges, and all public buildings, in hotels and office buildings.

In hotels and establishments where watchmen are on duty at all hours of the night, the fire alarm bell is located in the building which is protected. In other cases the bell is placed at some neighboring point where it will attract attention, and is connected to the building by an insulated wire. In cities the bell is frequently located in a neighboring fire-engine house. The fire departments, recognizing the great utility and reliable character of the system, have always been very willing to receive and respond to the calls of this alarm. In Chicago and St. Louis, most of the important buildings are fitted up under one comprehensive system, which terminates at the Fire Insurance Patrol, or Salvage Station, established and maintained by the insurance interests. In Chicago there are nearly one hundred buildings so protected.

Such is the confidence placed in this apparatus by those who know its worth, that insurance companies make a liberal reduction on the rate of insurance to parties whose property is protected by the alarm.

The Induction of Currents in Cores.

By Oliver Heaviside.

Comparison of Current Induction in a Core with a Case of Fluid Motion.

In order to obtain a full mental representation of the state of things in a physical problem of one kind, it may often be of some assistance if we can find one of another kind in which the quantities concerned are similarly connected. Thus, in the theory of the torsion of a solid elastic prism, to get a general idea of the warping that takes place when the section of the prism is not circular, and of the amount of its effect on the torsional rigidity, we may be assisted by the comparison with a hydro-kinetic problem, in which the rotation about its axis of a box of the same shape as the prism, filled with incompressible perfect liquid, sets the liquid itself in motion when the section is not circular (Thomson and Tait, II., Art. 706). Suppose now the problem is one in which certain quantities subjected to given laws go through a series of complex changes in passing from one state to another. If we find another physical problem in which other quantities go through the same changes we have an interesting analogy, to say the least, even if the substituted problem be not more easily conceivable than the original. But further, if in the substituted question the quantities concerned are everyday realities, so that their connections are readily grasped, we have not merely an interesting but a useful and valuable comparison. Again, though this is quite a separate matter and may or may not apply, we may possibly get some assistance in forming a physical theory of the unknown phenomena for which has been found a dynamical analogue.

Start the current in a circuit containing a coil with a conducting core by closing connection with a battery. In the transition from the initial state of no current, or magnetic, force to the final state of steady current in the coil circuit alone and uniform magnetic force in the core, a series of complex changes, generally referred to as current induction, is gone through by the magnetic force and the current, and something more than a superficial examination is needed to obtain a good grasp of the phenomena as a whole. We require, then, an analogous case in which we can readily see the course of events. There are various comparisons which may be made, but the substitutions are not usually sufficiently simple for the purpose. The only one that I can find that is so, is the comparison of the magnetic force in the core with the motion of water in a pipe of the same shape. This requires some explanation before the correctness of the comparison can be appreciated.

Magnetic induction is mathematically subject to the law of continuity of an incompressible perfect liquid. This alone is of valuable assistance when we are regarding the nature of distribution of lines of force in a magnetic field. Further, if we ask what it is in the liquid motion that corresponds to the electric currents that accompany the magnetic force, the answer is that a current line is represented by a vortex line, a current tube of infinitesimal section by a vortex tube of infinitesimal section, the fluid within which is, at the moment, rotating with an angular velocity proportional to the strength of current in the current tube, the axis of rotation being that of the tube. As current tubes are closed upon themselves, so are vortex tubes in a moving liquid. Any possible state of magnetic force with its corresponding electric current has its analogue in a similar state of liquid motion, lines of magnetic force being translated into lines of liquid velocity, and lines of electric current to vortex lines.

The Newtonian equation of motion of a fluid particle, meaning thereby an extremely small portion of the fluid, expressing symbolically the definition of a force as the acceleration of momentum it would produce if it lasted for the unit of time, is

$$\mathrm{F} = \delta \frac{\mathrm{D}v}{dt},$$

where δ is the density, F the force acting upon δ, or the force per unit volume, since δ is the mass per unit volume; δv the momentum, and $\mathrm{D}v/dt$ the acceleration of δ's velocity. It is to be remembered that the force produces its full effect in the direction of its action, irrespective of what the actual velocity of the mass acted upon may be. F and v are vectors, and so is $\mathrm{D}v/dt$, which is a vector parallel to F.

The force F is partly due to the stress on the particle arising from the matter around it, and partly to other causes, which we sum up under the name of external force, acting bodily on the fluid, by unknown agency. The force of gravity, for instance, which appears to act upon matter independently of the matter around it, is treated as an external force.

In any fluid at rest, the internal stress is a simple pressure, equal in amount in all directions about a point, but in general varying in amount from one point to another. In the ideal perfect fluid this is also the state of stress when the fluid is changing its shape. The variation of pressure constitutes a force tending to alter the motion of a particle. Calling the pressure p, and disregarding external force, we have $\mathrm{F} = -\nabla p$, the vector decrease of pressure, and

$$-\nabla p = \delta \frac{\mathrm{D}v}{dt}$$

is the equation of motion of a fluid particle.

This insignificant looking equation contains volumes of meaning, even without abstruse mathematical investigations to open them out. In fact, there is involved by it, and immediately visible when one looks at it through the proper glasses, a most remarkable property, that of the constancy of the circulation, with astonishing consequences.

The pressure p is a scalar—that is, it has a definite value at every point of the fluid, and requires no directional specification. Its variation $-\nabla p$ is, of course, a vector, has a direction as well as a magnitude, being, in fact, the force acting upon δ. Bearing this in mind, consider the state of the fluid at a fixed moment, and the alteration of velocity made by the force just after. Select a closed chain of particles, and travel once round it. However the pressure may vary along the circuit, it comes back to its original value at the end. In mathematical language the line integral of the force $-\nabla p$ round the closed chain is zero. By the above equation the same property must be true of the quantity on the right side of the equation, that is, of the acceleration of momentum. Let δ be constant. Then the line integral of $\mathrm{D}v/dt$ is zero. Now, defining the "circulation" in a closed circuit to be the line integral of the velocity, *i.e.*, $\int \overline{vds}$, where ds is a vector element of the circuit, its variation with the time is due, first, to the variation in the velocity, and, next, to the variation of form of the moving circuit; that is

$$\frac{\mathrm{D}}{dt}\int \overline{vds} = \int \overline{\frac{\mathrm{D}v}{dt}ds} + \int \overline{v\frac{\mathrm{D}ds}{dt}}.$$

We have already seen that the first integral on the right side vanishes. In the second, $\frac{\mathrm{D}ds}{dt}$ is the rate at which the vector ds is changing, or the difference in the velocity at its ends, or $\frac{dv}{ds}(ds)$, making the quantity to be integrated $v\,\overline{\frac{dv}{ds}}(ds)$, or $\frac{d}{ds}(\frac{1}{2}v^2)(ds)$; which, being the variation along the circuit of a scalar, necessarily vanishes when summed up. Thus the circulation in the circuit does not change at all. The circulation along that circuit of particles, which may be at any circuit in the fluid, whatever value it may have at one moment, will always have that value, and what is more, always had it. Thus vortex lines move with the fluid, and vortex tubes keep their strengths unaltered, however they may change their shapes. This results from the constancy of the circulation along a closed line of particles embracing a vortex tube. The same reasoning applies when the density is not constant, but is a function of the pressure. Then $\nabla p/\delta$ has the same property as that above mentioned for ∇p. Also, if the external force per unit mass be, like gravity, reducible to central forces, the same applies to it. From the constancy of the circulation in a perfect fluid we have the indestructibility and uncreatability of vortex motion, possible permanent differentiation of portions of the fluid from the rest, and Sir Wm. Thomson's vortex atoms. Truly there is poetry in science that infinitely transcends the school-girl poetry of belauded and belorded poets, which is, however, no doubt quite suitable for such matters as catching blue flies on the window pane, or calling me early, mother, dear.

Although the equations of motion of a perfect fluid were formulated by Euler in 1755–59, and dozens of eminent men had been working at hydro-kinetics later, a whole century elapsed before the property of the constancy of the circulation was discovered. No one had put on the right glasses, or had managed to focus them correctly, until Helmholtz in 1858 discovered the properties of vortex motion in a perfect liquid, followed a few years later by Sir W. Thomson's extension of the same to compressible perfect fluids, by his theorem of constant circulation, from which, in fact, they follow by elementary reasoning. We are here reminded of another doctor, who discovered another kind of circulation; we refer to Dr. Harvey, and the circulation of the blood. But the circulation of the blood is not constant. For the blood is a viscous fluid, requiring the continual application of force to keep up its circulation. That this is so is much to be rejoiced at by all good men; for, were it otherwise, we should live forever, and no longer have, as at present, the inexpressible satisfaction of looking forward to a time when we shall console ourselves for the troubles of this life by playing on the harp in the next. Everything is for the best.

Now, since every state of incompressible perfect liquid motion represents a system of magnetic force, as the liquid moves and carries its vortices along with it, its motion remains the representative of the magnetic field of a definite system of closed electric currents similarly moved. But obviously this system of currents does *not* correspond to what would happen in a conducting mass if we started with a given arrangement of magnetic force and then left it to itself. For the magnetic system subsides through the frictional generation of heat by the electric currents which accompany it, whilst the constancy of the circulation precludes the motion of the perfect liquid ceasing. We must introduce viscosity, or internal friction; in other words, give the liquid that property which all known fluids possess. That real fluids are viscous is known to the commonest observation. When at rest, equilibrium requires that there should be no tangential stresses; when the parts of a fluid are changing shape there must be, because we can set fluids in motion by purely tangential stress. The typical illustration is that of the circular bowl containing water set rotating about its vertical axis. If there were no tangential stresses the water would remain at rest. In reality, the tangential stress at its moving solid boundary pulls the outside layer of water round after the bowl, the outside layer pulls the next inner one, and so on up to the axis, where the water is the longest in getting up its motion. The final state is that the vessel and water rotate as one solid body. On stopping the bowl it drags back or retards the outer layer, then the next inside, and so on to the center, where the liquid keeps up its motion the longest.

These tangential stresses are defined in amount by the coefficient of viscosity or of sliding friction. Let liquid be moving in horizontal layers in a definite direction, and let the velocity in any layer be proportional to its distance from the lowest layer, so that if x is the height of a layer, $v = ax$ is its velocity, a being constant. Let the motion be from left to right. Any layer is moving faster than the one below it, and slower than the one above it, and there is mutual stress of the frictional character between contiguous layers thus sliding, of amount ma per unit of area in contact, where a is the constant just mentioned—viz., the upward rate of increase of velocity, and m is the coefficient of viscosity.

Now in the equation of motion of a particle we have to take into account, in the expression of F, of any force on δ arising from the sliding friction set up by the distortion it experiences in general as it moves. The result, by the analysis of stresses and strains, is, in the case of an incompressible liquid, to introduce a new force acting on the particle besides that arising from variation of pressure. Not to go into details which are not wanted here, this force is represented by $-m\nabla^2 v$, which makes the equation of motion

$$\mathrm{F} - \nabla p - m\nabla^2 v = \delta \frac{\mathrm{D}v}{dt}$$

where F is restricted to be the external force only. The constancy of the circulation is gone, fluid motion may be started by tangential stress alone, and, should there be no forces to keep it up, will cease by surface and internal friction, the energy of the motion producing heat. The rate of dissipation for the whole liquid by internal friction is $4m\Sigma$ (ang. vel.)^2 per second.

But the special case to which our electrical problem corresponds is easily worked out. Let there be a long straight pipe of circular section, containing water or other practically incompressible viscous liquid, and let the motion be parallel to the length of the pipe, say from left to right, and be in cylindrical layers, *i.e.*, only varying in velocity from one layer to another. The cylindrical layers may slide over one another, but liquid must not move nearer to or further away from the axis of the pipe. Consider a layer of radius r and thickness dr moving with velocity v at r. The outward rate of increase of velocity being dv/dr (the a above), the whole tangential force on the inner boundary of the layer per unit of length of pipe is

$$2\pi rm\frac{dv}{dr} \text{ from right to left,}$$

and on the outer boundary,

the same, $+\frac{d}{dr}\left(2\pi rm\frac{dv}{dr}\right)dr$, from left to right.

The resultant moving force is therefore

$$2\pi m\frac{d}{dr}\,r\frac{dv}{dr}dr, \text{ from left to right,}$$

which must equal the acceleration of momentum

$$2\pi r dr\delta\frac{dv}{dt},$$

if there be no other forces. Equating the last two expressions we find

$$\frac{1}{r}\frac{d}{dr}r\frac{dv}{dr}=\frac{\delta}{m}\frac{dv}{dt} \quad . \quad . \quad . \quad (62)$$

for the equation of motion of the layer of radius r. Comparing this with equation (14), for the magnetic force in the circular core inside a solenoidal coil, we see that they are of the same form. Magnetic force parallel to the axis is replaced by liquid velocity parallel to the axis, specific resistance by coefficient of viscosity, and magnetic permeability by liquid density. (Of course there is also the silly 4π in the electrical case, arising from the faulty definition of the strength of a pole.)

There may besides be, in the liquid, force arising from variation of pressure; but we do not require it. Let the ends of the long pipe be joined together, or immersed in the ocean, and let the liquid be set in motion by uniform tangential force applied to its boundary, acting parallel to the length of the pipe of strength X per unit of surface. The surface equation of the liquid is of the same form as the boundary equation of magnetic force in the core, *i.e.*, the equation of E.M.F. in the coil surrounding it. For, if m_1 be the coefficient of sliding friction between the liquid and the solid pipe, the frictional retarding force on the outer layer of liquid is $m_1 v$ per unit area, making $X-m_1 v$ the actual force from left to right on the outer side of the boundary layer per unit area. On the other side of the layer, of infinitesimal thickness dr, there is the frictional stress acting in the opposite direction, of amount $m dv/dr$ per unit area, so the equation of motion of the layer is

$$(X-m_1 v)-m\frac{dv}{dr}=\delta dr\frac{dv}{dt}$$

the right hand member of which vanishes with dr, thus giving

$$X=m_1 v+m\frac{dv}{dr} \quad . \quad . \quad . \quad (63)$$

for the boundary equation. Comparing this with equation (20), which we may write (using (6) and (15),

$$\frac{E}{l_1}=\frac{R}{4\pi N l_1}H+\frac{\rho}{4\pi}\frac{dH}{dr} \quad . \quad . \quad (20A)$$

where l_1 is the whole length of wire in the coil, we see that the boundary equations are of the same form when the depth of the coil is small compared with its radius, and the core fills the interior space. (A modification can be made in the liquid problem to make the boundary equations agree when the coil is not of small depth.)

Having thus a perfect correspondence of mathematical conditions, we may, in considering the nature of induction in the core, dismiss altogether the complicated and cumbrous imagery of a set of currents acting and reacting upon one another at a distance, which it is only possible to manage in simple cases, and substitute the following method:

Let an E. M. F. act in the coil circuit, variable in any arbitrary manner. The magnetic force set up in the core will, at any moment and at every place correspond in direction and intensity with the fluid velocity set up in a pipe similar to the core, filled with incompressible viscous liquid, if it be acted upon by superficially applied tangential force, uniform in amount per unit area, acting parallel to the axis, such force to vary in intensity in the same manner as the applied E. M. F. in the former case. Of course the viscosity, surface friction and density of the liquid must be properly chosen to suit the electrical data, as we may see on comparing (62) with (14), and (63) with (20*a*).

The wave-like propagation of magnetic force into the core from its boundary when an oscillatory E. N. F. acts in the coil circuit, and the rapid decrease of amplitude in going inward, and the insignificance of the magnetic force except near the boundary when the oscillations are rapid, are made perfectly easy to follow by the fluid anologue, wherein, with a similar to and fro tangential force on the liquid boundary, the motion is propagated inward by means of sliding friction.

In the core the current density is $-\frac{1}{4\pi}\frac{dH}{dr}$ and the current lines are circles in planes perpendicular to axis. In the pipe the angular velocity of instantaneous rotation is $-\frac{1}{2}\frac{dv}{dr}$ and the vortex lines are similar circles. That the fluid moving in straight lines can be rotating will be seen, by considering that if we impress upon every part of a small mass of the fluid in which the velocity varies a velocity equal to that of its central portion, but in the reverse direction—that is, do away with its bodily translational velocity—there is left only the relative motion of its parts, and that consists of a shear combined with an equal similar rotation. There is current in the core at any point only when the magnetic force varies in the neighborhood, and in the liquid there is differential rotation only when there is sliding of layers. The heat of the induced currents corresponds to the frictional heat developed by the sliding, and the coil heat to the heat of friction against the pipe. The case of steady E. M. F. in the coil will be next considered, and graphically illustrated.—*London Electrician.*

The Queer Career of M. Volkmar, Who Killed Himself in Paris.

The career of M. Volkmar, the banker and speculator of Paris, who committed suicide in that city, was in many respects a remarkable one. A gentleman of New York, who was connected with the Faure Electric Storage Company, said: "Volkmar began as a workman in M. Faure's electrical factory in Paris. While there he studied the Faure patent for the storing of electricity, which was a leaden plate immersed in a chemical bath, and he conceived the idea of manufacturing the accumulator on his own account. Leaving M. Faure's employment he went to England, where, in 1882, he endeavored to get a patent for a so-called improvement of the Faure apparatus, his improvement consisting merely of a perforated plate, instead of a solid one. The British Patent Office, however, refused to grant letters patent on so small an improvement, and, besides, there was doubt as to whether the additional surface gained by the perforation was a new idea. He formed a partnership with Mr. Sellon in the same year, and they began manufacturing the Volkmar-Sellon improved plate. They did well, and I imagine that Volkmar took out of the enterprise $500,000. Then his partners, disliking his methods of business, offered him a small sum to withdraw from the firm, or threatened to force him out. He took the small sum and went to Paris.

"The possession of so much money troubled him, so he consulted with M. Philipart, the most famous speculator who has appeared in Europe since George Law's day. Philipart gave him some points, and he speculated on the Paris Bourse. Volkmar was active until his death, but lately he suffered so many severe losses that he became despondent. His system of storage is in general use even now in England and the United States.

New Battery With an Alkaline Liquid.

Professors Fabri and Ravaglia communicate the following to *La Lumiere Electrique:*

The alkaline liquid batteries, and especially that of MM. Laland and Chaperon with oxide of copper have latterly attracted the attention of electricians.

The inventors have undertaken to render their battery as practical as possible, so as to render it fit for industrial and scientific uses.

Whilst admitting the merits of this battery we are persuaded, after prolonged experimentation, that the oxide of copper may be advantageously omitted, taking, as the positive pole of the battery retort, carbon broken into small fragments. Although it is not easy to suppose any true chemical action taking place in the carbon, yet experience has shown us that a positive element thus formed is polarized only with great difficulty, so that it may be usefully employed in our battery, even when kept for a long time in action with a closed circuit.

The form which seems to us the best for our battery resembles that of the Leclanché element.

The zinc, which must be carefully amalgamated, is immersed in a solution of caustic potash contained in a glass vessel.

The positive pole is in the middle, and is formed of a cylindrical vessel of very porous earth, the sides of which are perforated with a large number of holes large enough to let the liquid penetrate without allowing the fragments of carbon contained in the same vessel to escape. In the center is placed a small rod of carbon, which serves as an electrode, and for which may, without inconvenience, be substituted a plate or a stout wire of copper.

DIAGRAM OF LONG DISTANCE WESTERN ELECTRIC CALL BELL.

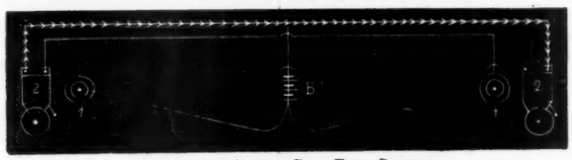


DIAGRAM OF SIMPLE CALL BELL SYSTEM.

As soon as our battery is set in action it develops a considerable electromotive force, which may sometimes amount to 1.60 volts, but this electromotive force then decreases very rapidly down to a limit, which depends on the resistance of the circuit as compared with the magnitude of the battery. With an external resistance of a few ohms we obtain a permanent action differing very little from 1 volt.

Nevertheless the great power of this battery, as of that of MM. Lalande and Chaperon depends on the low internal resistance which renders it possible to obtain very intense currents with relatively feeble electromotive forces. But even in this respect it seems to us advantageous to substitute carbon for the metallic oxides which have a weaker conductivity.

We are studying, at present, the most practical manner for regenerating the alkaline solution so as to utilize the products of the decomposition of the zinc (?); and we hope shortly to present to men of science, and to industrialists, a battery convenient and economical, both as regards the first outlay and the working cost, and which may be advantageously substituted for the Leclanche battery.

Already, for some time, a battery on our system has been applied to the fire alarm apparatus at the Alighieri Theater at Ravenna, and, so far, the instruments attached to this apparatus to give warning of any decline of action in the battery have not indicated any need for setting in action a reserve battery which is always kept ready in the theater.

Finally, we propose continuing our researches in order to ascertain what is the action of the carbon in our battery. Researches, which may possibly lead to the explanation of other phenomena presented by batteries with solid depolarizers, and which may present some scientific interest, since it is certain that, on setting out from the calories corresponding to the formation of the oxide of zinc, and to its combination with potassa, and taking into account the hydrogen set free at the positive pole, we obtain for the electromotive force a quantity of heat strikingly inferior to that which results from the measurement made directly at the battery.

This may, in part, depend on the large surface presented by the small fragments of carbon in proportion to the zinc, but it seems to us that this does not suffice for the complete explanation of the phenomenon.

The absorbing power of the carbon for the oxygen of the air being much superior to that of the hydrogen produced by the chemical action of the potash upon the zinc may, perhaps, contribute to increase the electromotive force of the battery.

Electro-Magnetic Induction.

At the London Physical Society, recently, Mr. C. V. Boys exhibited the phenomenon first observed by Faraday, in which a copper disc suspended bifilarly between the poles of an electro-magnet, so as to cross the lines of magnetic force at an angle, is suddenly kicked or twisted parallel with the lines of force when the magnet is excited. If the disc be perpendicular to the lines of force it is repelled by a pole when the magnet is made, and attracted by the same pole when the magnet is unmade. Mr. Boys has investigated the phenomenon very fully, and points out that it offers a quick and ready means of measuring the intensity of an electro-magnetic field, as well as a means of finding the electric resistance of plates and discs of metal.

Before the Telegraph Came.

Moses S. Beach, in New York *Sun*: "We never used the telegraph much until the Mexican war. There is a little building on the roof of the *Commercial Advertiser* building which was built originally for a pigeon-house, and where at one time we had two or three hundred pigeons. This enterprise was started about 1844, first on the Pearl street house, because we did not want it to be known what we were about, and a man named D. H. Craig was employed to take care of and train these birds, and after the thing had become partially successful we removed them to the top of our building, because there was much time lost in the transmission of the news from the Pearl street house to the office. The pigeon scheme was not entirely successful, although it enabled us to get out some extras ahead of our rivals. We had trained them so that they would fly from New Haven to the office in one and one-half or two hours. We used them successfully from the race course on Long Island, and for short distances they did well. I went down to Charleston to report the proceedings of the presidential convention, and had a basket of pigeons which I loosed at Rahway, and when I got to the city the extra *Sun* met me at the Courtland street Ferry.

"We had also a method of telegraphing by light or signals, but we never made much of it; I had planned out a system of telegraphing by the semaphore, and intended to get the steamer news from Boston in that way; but the electric system was perfected, and that revolutionized journalism altogether.

"I should say, in regard to reporting, that a man named Sutton came over from England, who had been a shorthand writer on the *London Times*, and I think he was the first phonographer in New York. He established a school here, and I took lessons from him. Before that Davis and the other reporters had each his own system of abbreviated long-hand, but I think that verbatim reporting began with the advent of this man Sutton in—if my memory serves—the year 1836."

Electrical Review.

Published Weekly at 23 Park Row.

P. O. BOX 3329.

GEO. WORTHINGTON, } - - - Editors.
WM. A. HOVEY, }
THOMAS H. DELANO, - - - - Publisher.

SUBSCRIPTION.

United States and Canada, $3.00 per annum, in advance.

Great Britain and other foreign countries, $4.00, in advance. Postage free.

EDITORIAL ANNOUNCEMENT.

Address all communications and make all checks and P. O. orders payable to order of Delano and Company, Proprietors. P. O. Box 3329, New York.

We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Subscribers can at any time have the mailing address of their paper changed by sending both old and new address.

NEW YORK, AUGUST 9, 1884.

CONTENTS.

	PAGE
Western Electric Specialties	1, 2
Induction of Currents in Cores	2, 3
Queer Career of M. Volkmar	3
New Battery with an Alkaline Liquid	3
Electro-Magnetic Induction	3
Before the Telegraph Came	3
Editorial Notes	4
Electric Railways	4
A Cable to the Pole	4
More Than he Can Chew	4
Some Telegraphic Facts	4
Is Gas a Dangerous Illuminant?	5
Electricity and Rapid Transit	5
Telephone Troubles in Connecticut	5
Rules for the Installation at the Philadelphia Exposition	5
Telephonic News	6
The Telegraph	7
Novel Telephone Support	6
Lightning Arrester for Electric Light Lines	6
Organization of the Post and Telegraph Service in France	6, 7
The McCabe Cut-Out	7
Electrical and Scientific	8
Electricity as a Motor	8
An Electrical Testing Establishment	8
The Broadway Electric Road	9
The Electric Light News	9
Electric Metallurgy	9
Electrical Engineering	9
An Electric Tramway Car	9
New Electrical Patents	10

Mr. Edison has been talking again, this time on electric motors. It is interesting to learn his position upon this important and complex question, and if he stands firmly to his expressed convictions, it would seem that some solution would soon be reached. Without going into the merits of the case, we would simply say that Mr. Edison is right in his determination to hold his full share in the pool which was organized to forward the joint interests of both inventors, and the time for him to withdraw from the consolidation was before decisions had been reached upon the patents, and not after. To do so now would only tend to complicate matters and imperil the interests of those who have in good faith bought stock and put money into the enterprise. It is also gratifying to learn that Mr. Edison is shortly to resume "original experimenting again," and that he will "get out a new crop of inventions during the next year." When Mr. Edison left his laboratory at Menlo Park, we felt that the science had, in a measure, lost one of its most careful students and prolific inventors. The change from the laboratory to the office should have produced beneficial results in a directly practical channel, which will doubtless prove valuable in future experimenting.

Preparations are being vigorously pushed forward for the approaching Electrical Exhibition at 32d St. and Lancaster Ave., Philadelphia. The building itself is practically complete, and foundations are now being laid for the five engines which are to propel the machinery during the Exposition. The largest of these engines will be a 300 horse-power, with a capacity of 180 revolutions a minute.

The engines have a combined power of about 600 horses. The magnificent electrical fountain which is to occupy the center of the hall is partially finished. Probably the most interesting feature of the exhibition will be the great Edison thirty-ton dynamo machine. This will be the largest dynamo ever constructed, and will be sufficient to supply most of the light for the building if necessary. The foundations for this monster lighting machine are now being prepared, and will be completed in a few days. Among the most curious things which will be on exhibition during the Exposition will be the original Morse telegraph instrument, upon which the first electrical message ever telegraphed over a wire was sent from Washington to Baltimore. As a comparison to the simple key with which Professor Morse sent his first message there will be placed side by side with it a synchronous multiplex telegraphic machine, by which an operator can send seventy-two messages at once over one wire. There will also be an electric chicken-hatching machine. The number of electric curiosities will be very great.

ELECTRIC RAILWAYS.

Slowly, but not the less surely, the electric railway is coming to the front as a practical thing. Mr. Stephen D. Field has just secured a victory in the Patent Office over Edison and Siemens, after a long and tedious fight, and the way is now cleared for further progress. Mr. Field, being interviewed this week, said:

"I have won the four years' fight with Siemens and Edison, but I cannot say yet when electricity will replace steam on the elevated road. I have allowed my rights to be hampered by a sort of co-partnership arrangement with Edison, and now Edison is acting the dog in the manger, and refuses to retire and allow me to do the best I can with the invention. It has been impossible to do anything practical so long as several persons were fighting for the right to an invention upon which all electric railway motors are founded. My patent covers the use as conductors of the rails upon which the cars run, or of a supplemental rail either outside or between the two tracks, or sunk in the ground. I do not cover the system of carrying the electricity above the tracks upon wires suspended from poles, but that is of no permanent value, and can be used only as a toy. Every electric railway in the country is an unquestionable infringement of my rights, for all send the electricity to the motors by way of the rails.

"There is no more doubt that electricity will replace steam as a motive power for railways on short distances than that steam has replaced horses on long ones. But we cannot do everything at once. Stephenson's first steam engine would not pull one of the heavy cars now in use on all our railroads, and there must be a gradual advance. For the present we know enough to enable us to make electricity do the work of horses or steam upon short roads of not more than ten miles. Siemens, of London, offered last year to come over here and run our elevated road trains by electricity, and we can do just as good work as they can. Eventually I believe that we shall run across the Continent by electricity, but that is in the future; we have no means of doing anything of the kind at present. What we are prepared to do at once is to run every railroad of not more than ten miles by electricity, at less expense and far more satisfactorily than can be done by steam or horse power.

"I cannot say just now what our first step will be. If Edison wants to prevent me from going ahead and building electric railways, I may go ahead all the same and allow him to sue for any damages to which he may think himself entitled under his contract with me. But one thing is certain: you will see electric railways all over the country before many years. Litigation is about the most discouraging thing that an inventor meets with, for he pays all the money he can rake and scrape to lawyers, and in the end some accident may bring in some other inventor ahead. So long as I had no patent to show I was helpless. Now the entire situation is changed and I can get assistance."

A CABLE TO THE POLE.

Some one who evidently has no faith in the idea that there is such a thing as an impossibility, writes as follows to the Boston *Daily Advertiser*:

"While the whole country—and, indeed, the civilized world—is rejoicing at the rescue of the survivors of the Greely expedition, and at the same time sorrowing for the loss of their brave comrades by such a horrible death as starvation, it rises in one's mind that such a fate might have been made almost impossible to them, if science in one of its best known forms had been brought into operation. And, indeed, if the polar question is ever to be settled, it must, I believe, be principally through its intervention.

"Had the expedition been connected with civilized life by the telegraph it seems as if not only would two rescue expeditions have been rendered unnecessary, but the brave lives now gone would have been preserved, the public would have had daily information of their movements, the interests of science would have been greatly advanced, and who knows but that, fortified by the knowledge of their connection with their fellow men, they might have been enabled to make a dash for the pole, and thus have secured for their country the much coveted honor of first reaching it.

"A permanent cable laid from Newfoundland to Disco, thence to farthest point practicable, and a supplementary cable carried by them on board ship, and paid out from that point as they went along, would, I presume, be necessary. Although the cost might be considerable, still it would not exceed the continuous expense caused by these successive expeditions, and it would enable the explorations to be conducted on a comparatively safe basis, besides adding to our knowledge of the meteorological conditions existing North. Probably such a cable would also be of immense use to whaling ships, and although it would not pay monetarily; it would certainly do so scientifically."

It would be interesting to obtain from those who have lived in and are familar with these far off regions their idea of the practicability of such a scheme. It is very certain that, if there is ever to be any successful arctic exploration, it must be the first thought of those engaged in it to keep their lines of retreat constantly open, and to maintain, in some way, constant communication with civilization. Those who seek to capture the Pole must not be a mere handful of men, thrown out like a forlorn hope, but a well diciplined force of sufficient numbers to man and hold every point gained, keeping up, by any and every means known to science, constant communication between the most advanced outposts, and the reserve, which must, in its turn, be in constant communication with the civilized world. And no one can doubt that in such an enterprise, electricity would play a very important part.

MORE THAN HE CAN CHEW.

If we may trust the report of a recent inview with Mr. Edison concerning electric motors for railway use, he has, to use a common but expressive phrase, "bitten off more than he can chew." His words were these: "Mr. Field tried an experiment concerning the use of electricity as a motor with an elevator, and he calls that applying the motor to a railroad, and says that if it will go up and down, a car will go along on a track. I have built a railroad three miles long at Menlo Park, on which I ran at the rate of forty-two miles an hour with my electric motor, and carried six or eight freight cars. It is a real practical thing. *I could not go on with it because I had not time. I had too many things to attend to, especially in connection with electric lighting.* Field's people were afraid they would lose their patents, and wanted to consolidate with me. The practical parts of the invention are mine. I consolidated with them, and since that they have done nothing. If I had been separated from them in this matter I would have appealed the case and would have won it, but as we were consolidated I do not need to do it, and now, because I did not defend the case, he wants to withdraw his patents from the pool. I am not willing to let him withdraw after having put my invention in and allowed him to get his decision. He couldn't have got it on any such nonsense as running an elevator; I am willing he should apply it to the elevated railroad. If he wants to do so he can have all the profits so far as I am concerned. I guess all the others interested would consent to have it introduced in this way. I am keeping pretty busy. I am going into original experimenting again. I'll get out a new crop of inventions during the next year on the electrical line."

Concerning the differences and difficulties that have arisen between Mr. Edison and Mr. Field concerning their respective interests in the electric railway patents, it can only be said that it is very unfortunate that they exist, and that, up to the present time, it has been supposed that these and other similar complications were the true cause of the delay in bringing the electric railway into use in this country. But it seems that there is an underlying cause. It is the fact that Mr. Edison has undertaken so much that he could not accomplish it all, and, after bringing the electric railway to practical success at Menlo Park, had to drop it because his attention was necessarily devoted to the electric light. One might hope that, now that his light is in such general use, he would turn back to the Electric Railway and bring it into use, but no, he is "going into original experimenting again," and we are to have a big batch of new inventions. No one who appreciates the fertility and value of Mr. Edison's inventive power can for a moment regret this, and yet it seems a pity that the Electric Railway should lag and drag along as it has, without showing any practical results. So long as a cloud of uncertainty hangs over the patents, it will be hard to get capital interested in it. That difficulty once out of the way, there ought to be no trouble.

SOME TELEGRAPHIC FACTS.

If the experience which the past has given us is any measure of what the future has in store, we may look for an increase of telegraph business in the next ten years out of all proportion to the expectations of the most sanguine. Those who take pains to sit down and compile statistics and institute comparisons get at this pretty accurately, but now and again there comes along an opportunity to make comparisons which are startling in what they disclose. For instance: Every one knows that the result at the Chicago Republican Convention of 1860 was looked forward to with the utmost anxiety, because to many it seemed as though the fate of the Nation was trembling in the balance. In the convention building the Western Union had an operator who sent all the associated press dispatches, and he proved fully equal to the work. In the Republican Convention this year Western Union Company established a regular office, with over *one hundred* operators, and, these proving inadequate to do the business, a regular line of messenger boys was kept constantly running between the convention building and the regular telegraph office in order to clear away the surplus. In addition to these, three other companies had regularly established offices in the building, each with a large staff of operators. There were several papers which, for their own use alone, sent in "specials" a larger number of words than were sent to the whole press of the country in 1860.

The impressing part of all this is that no one seems to have thought for a moment that there was any too much telegraphing from the Convention held this summer, or that the Western Union, in making their arrangements, were proceeding upon too liberal or generous a scale. The fact is, that the demand for fuller and more liberal telegraphing has come upon us so gradually and steadily that we have not noticed it, and have learned to look for it as a matter of course.

Is Gas a Dangerous Illuminant?

The paraded safety of gas has received several set-backs of late. Among them, and by far the most serious, was the total destruction of the Pennsylvania Railroad Depot at Jersey City on last Monday night. The conflagration was started by the explosion of the gas reservoir, located directly under the ticket office, which set fire to the building, and the escaping gas, adding fuel to the flame, soon consumed that and other adjoining buildings.

The *Sun* says: "The employes had been smelling escaping gas for weeks at the ferry ticket offices near the entrance at Montgomery Street. At 11.15 P. M. Ferry Master Robert Jones was alone in the right-hand ticket office, his assistant in the opposite office having closed up and gone home. A lady had just stepped up to buy a ticket, when a terrific explosion occurred directly beneath the seat of the ticket-seller. The lady was thrown backward upon the sidewalk, but was not severely injured. She walked home. The ferry master was blown fully six feet into the air and struck the ceiling of the booth, and dropped scorched and senseless to the floor. He recovered consciousness in a moment, and escaped just in time from the building, which was soon in flames. Immediately following the explosion a sheet of flame shot into the air. The fire spread with marvelous rapidity along over 300 feet of water front. It was conjectured by some that the fire had spread through the gas pipes, and that the first explosion had been followed up by others."

The total loss is estimated by the N. Y. *Times* at $500,000. The same paper also states that there were five persons more or less seriously injured by the explosions, but none of them fatally. All of the morning papers of Tuesday verify the statement of the *Times*, and we are therefore inclined to believe its statements. We would call the attention of our daily contemporary to a few facts mentioned in the REVIEW last December regarding the loss of property and life by electricity. All of the statements at that time published by the *Times* were proven to be false; but, as far as we are able to learn, not one word of correction has ever been published. We now have the evidence that the *Times* can print the truth, and we would ask for a simple, plain denial of the false statements at that time indulged in. It would also be interesting to have our contemporary publish a comparative table of the losses caused by the two illuminants—gas and electricity—and we predict that no such foolish abuse will ever appear in its columns thereafter.

The total loss of property by electricity, so far as learned to date, will not exceed $500. Against that we have one fire from gas at which $500,000 worth of property was destroyed.

No lives were lost at the Jersey City fire, but, had the explosion taken place at almost any other hour of the day, the consequences would have been more serious. If it had taken place in the morning or afternoon, when two or three hundred men, women and children were awaiting the arrival and departure of trains and boats, the results would have been appaling. The simple statement of fact is conclusive. It requires no argument to prove that gas is an unsafe and dangerous illuminant.

Widening the Sphere of Electric Light.

Experiments to ascertain if the electric spark can be made to burn steadily enough for purposes to which its power strongly recommends it are being conducted by the Electrical Committee of the Franklin Institute. Tests have been made by means of a microscope and projecting lantern with a Brush electric focusing lamp operated by a Brush dynamo engine. The Holman lantern microscope, operated by Professor Holman, was placed immediately in front of the lamp with its lenses ranged so as to throw the light in a disk upon a suspended screen. Several microscopic objects were placed in front of the lamp and reflected upon the screen. In this manner the throat of a fly and the leg of a spider were shown with great distinctness, the light being so steady as to allow a careful and most minute examination of the insect anatomy.

Electricity and Rapid Transit.

The recent successful use of electricity as a motor on a Cleveland street railway is of interest, as being the first made in this country on so large a scale and for a utilitarian purpose. Experiments of the same kind have been made in workshops or laboratories, but this union of the practical and experimental showed that only patience, intelligence and money are required to perfect and apply this motor.

For some time a railway using electricity as a motor has been in successful operation at Berlin; while at Vienna, during the recent electrical exhibition, another, a mile long, carried many hundreds of thousands of passengers. Other experimental applications of electrical motive power have been made, both on water and land, but have not yet proved their practical value as a permanent power. But practical science is making rapid advance in this direction, and will, no doubt, soon enable inventors to bring the various applications down to the demands of investors, and thence into popular adoption and use.

Nothing could be more welcome than such an application in large cities, which are now more seriously hampered in their growth by the lack of cheap rapid transit than from all other causes combined. When the advantages of city business and surroundings can be combined with suburban residence, with safe and rapid travel between them, the increase of urban population will be most surprising. The Cleveland experiment, and its adoption in that city as a permanent power, ought to insure its rapid progress, and work the abandonment of the antiquated methods now in use.

Telephone Troubles in Connecticut.

There is an evident determination to make things lively in Connecticut, despite the summer dullness. The United States Telephone Manufacturing Company, whose office is at 187 Broadway, in this city, caused ten thousand copies of the following circular to be printed, and sent one to every subscriber of the Southern New England Telephone Company:

TO ALL WHOM IT MAY CONCERN.

The undersigned, the United States Telephone Manufacturing Company, begs leave to announce that it is the owner of various letters patent of the United States granted to James W. McDonough, for inventions relating to telephones.

These patents are the following:

No. 245,534, of date of August 9th, 1881.
No. 246,800, " Sept. 6th, 1881.
No. 248,002, " Oct. 4th, 1881.

These particular patents have been carefully examined by some of the most experienced and eminent electrical experts and patent lawyers in the country, and it is their unanimous opinion that the telephone instruments now in use and known as the "Blake transmitter," and the "Bell receiver," are infringements of the said patents, and accordingly suit has already been brought by us in the United States Circuit Court for the District of Connecticut, against one of the companies who are using the instruments named.

It is a well established principle of law, that those who use a mechanism or apparatus that infringes a patent, are liable to the owner for damages and profits as well as those who make, sell or lease the same.

We take this method, therefore, to notify all persons who are using the Blake transmitter, or the Bell receiver, without license from us, that such use is a violation of our exclusive rights, guaranteed by the patents named as by various others owned by us, and that it is our intention to enforce our rights against all infringers, whether makers or users.

We give the public notice, in order that none may be taken by surprise when suit for infringement is brought against them.

THE UNITED STATES TELEPHONE MANUFACTURING COMPANY.
By H. H. ELDRED,
July 1, 1884. Asst. Genl. Mang.

We do not learn that this action has resulted in any great "scare" among the Bell subscribers, nor that the stockholders of the Southern New England Telephone Company have taken any special alarm. But it is an interesting incident in telephone litigation, and the result will be watched with much interest.

The Telephone in London.

The United Telephone Company of London expended on capital account last year $165,000. During the year the revenue increased $137,500, while the expenses increased only $27,500. An annual dividend of eight per cent. was declared. The president, in his report, presented at the annual general meeting recently held, stated that they were beginning to grapple earnestly with the important matter of depreciation, for which they had written off nearly $75,000 this year. Their business was still in its infancy, and they had, therefore, thought it well to transfer $50,000 to reserve fund, and to carry forward $25,000. This would make a reserve against depreciation of over $300,000. They had only been in existence for four years. For the first year, ended April, 1881, they had 914 subscribers on exchange lines, and there were 943,000 calls; while in the year ended April, 1884, they had 3,350 subscribers, and the calls had increased to 6,130,000. Private lines in the first year were only 186, whereas now they were 716. As to trunk wires connecting their exchanges in different towns, he could not report much progress. The position taken up by the Post Office had been so difficult and impracticable that they had found it useless to struggle against it. They were waiting to see what the result of the negotiations would be rather than commence that branch of their business on the lines laid down now by the Postmaster-General. With regard to their bill for the regulation of overhead wires, while the Government were not indisposed to go into the whole question, they would not allow the company to press forward a bill on their own account or introduce a bill of their own while litigation was pending as to the powers of local authorities on this matter.

Rules for the Installation of Electric Apparatus, at the Franklin Institute International Electrical Exhibition, Adopted by the Committee on Electrical Installation.

PREFATORY.

The following rules and regulations have been adopted for the purpose of securing the highest possible safety both to life and property. It is therefore earnestly requested that all exhibitors will give their hearty co-operation in carrying them into effect.

RULES.

1. All space granted to exhibitors in the International Electrical Exhibition, must be occupied in accordance with the rules and regulations of the Committee on Electrical Installation, and all exhibitors must agree to submit to the said rules before such space is allotted to them.

2. No circuits shall be run in the exhibition buildings until full plans and particulars thereof are first submitted to the committee, and approved by them.

3. No changes shall be made in any circuits without the consent of the committee.

4. Any question pertaining to the installation of electrical apparatus, that does not fall within the scope of these rules, must be referred to said committee for decision.

Circuits.—5. All circuits must be insulated and metallic throughout their entire extent; *i. e.*, no ground connections are to be used.

6. The conductors of all main circuits must have such a weight per running foot as will enable them to carry the current employed without heating.

7. When circuits are taken from large to small conductors, and the large conductor carries such a current as would dangerously raise the temperature of the smaller wire, if accidentally diverted through it, an approved automatic safety device must be introduced into the circuit of the smaller conductor, whereby the circuit will be automatically interrupted whenever the current passing through the smaller conductor is in excess of safety. Similar automatic safety devices must be used in all circuits run in the vicinity of electric light and power circuits.

8. All circuit wires for electric light or power currents must be insulated with some approved incombustible material.

9. Circuit wires exposed to moisture must have, in addition to their insulating covering, a coating of some water-proof material.

10. No paraffined or wax-covered wires are to be used in situations or under circumstances where they may be exposed to a high temperature.

11. When the electro-motive force of the current exceeds 300 volts, the different parts of a circuit outside the electro-generator, or the apparatus which it energizes, must not approach one another nearer than eight inches.

12. Aerial wires must not have a greater drop than one foot between points of support.

13. All circuits are to be run so as to permit ready and frequent inspection by the committee.

14. When practicable, the positive, or outgoing conductor must be clearly marked so as to distinguish it from the negative, or return conductor.

15. As far as practicable, continuous wires must be employed. Whenever joints are necessary, they must be made in such a manner as to insure a good and durable contact, and said joints must afterwards be insulated.

16. Wires fastened to walls and ceilings must be rigidly attached to the same by suitable insulating fastenings. In no case will loose loops in the same be permitted.

17. Where circuit wires pass through walls, floors, or ceilings, a special insulating, incombustible tubing must be used to encase the wire.

18. All electric light and power circuits must be tested as often as the committee may direct, for accidental grounds, or contacts, and if such are found, the currents shall in no case be permitted in such circuits until such grounds or defects are removed.

19. No circuits shall be placed underground within the building.

20. All underground conduits, in use as such, must be placed outside the main building, as may be directed by the committee, and all circuits connected therewith must be provided with safety devices.

Systems of Electric Lighting.—21. Dynamo-electric machines must in all cases be thoroughly insulated from the ground, and be surrounded by a railing so as to prevent the approach of the public nearer than two feet.

22. All dynamo-electric machines must be furnished with means to prevent the dangerous heating of their coils on the extinguishment of part of their lights, and if such means be not automatic in action, a competent person must be in charge of the machine while it is running.

23. Electric arc-lamps must be provided with an automatic switch or cut-off, so that the lamp will be automatically cut out from the circuit whenever the current traversing its coils reaches a dangerous limit.

24. All electric arc lamp frames must be insulated and provided with a hand switch to cut out the light when so desired.

25. All electric arc-lights used in the building must be protected by glass globes, furnished with a wire netting outside the globe, to keep the globe in place in case of accidental fracture. Broken or cracked globes must be promptly replaced by sound ones. The base of the globes must be enclosed so as to prevent the fall of heated particles.

26. A suitable device must be placed on all arc-lamps to prevent the fall of the lower carbon, on the failure of its holder.

27. The committee reserve the right to adopt the special preventatives in all cases where the safety of the public seems to demand it.

28. The committee reserve the right to modify these rules in particular cases where it is considered that circumstances warrant such modifications.

29. In all cases requiring prompt action, the exhibitors must be governed by the decision of the electrician until the matter can be acted upon by the committee.

EDWIN J. HOUSTON, *Chairman*,
HENRY MORTON,
CHARLES M. CRESSON, M. D.,
W. P. TATHAM,
M. B. SNYDER.

Telephonic News

*** A test of a telephone repeater, the invention of Mr. Daniel E. Smith, of the Hartford telephone office, was made between Boston and Newburyport last week. It was originally intended to have it occur between Boston and New York. The distance between Boston and Newburyport is 40 miles. The test was conducted by M. Jaques, the electrician of the Bell Telephone Company. A Smith instrument was put in position in each place, and the test was made wholly for the purpose of killing the induction, an evil which is so common and so well known, and it met with more than a gratifying success, not a sound being heard save the voices of the parties at either end. As soon as the wires between Boston and New York are in condition a test between those cities will be made.

*** The report of the New England Telephone Company for June is very satisfactory. It shows a net gain of 229 subscribers in June, and a present number of 18,437 subscribers. The extra territorial messages during the month were 28,282, a gain of 1,767 over the previous month; 511 cities and towns are now connected by telephone in this company. The net gain in subscribers by months since January 1 is as follows:

Net Gain.

January	459
February	183
March	185
April	130
May	252
June	229
Gain for six months	1,438

*** The Erie Telephone Company, on Friday last, declared a dividend of ½ of one per cent., paying August 9, to shareholders of record August 4. The books close from August 4 to 9. The dividend will amount to $24,000, and will be paid by checks mailed from Lowell. After the dividend, $16,000 will remain from the quarterly earnings, to be applied to a reduction of the floating indebtedness. The Erie has gained in six months, since January 1, 1,016 subscribers net. The quarterly statement of the Erie Company is as follows:

LOWELL, MASS., July 26, 1884.

To the President and Directors of the Erie Telegraph and Telephone Company:—Complete returns from the various divisions show the earnings, expenses and disbursements for the three months ending June 30, 1884, as follows:

Earnings.

Agency	$2,298 00
Exchange	121,420.87
Ex-territorial	6,341.59
Messenger	28.58
Telegraph commission	90.05
Toll lines	5,510.89
Miscellaneous	3 809.19

Expenses.

Operating	$29,107.02
Repairs and maintenance	7,822.69
Rent	1,557.05
Postage, printing and stationery.	642.39
Insurance and Taxes	2,132.81
Instrument rental exchange	27,511.14
" " agency	1,638.87
Interest	1,420.51
General expense account	980.46
Total expenses	$72,812.94
Total earnings	$139,499.17
Total expenses	72,812.91
Net earnings	66,686.23

which is at the rate of 5 55-100 per cent. on the issued capital, $4,800,000.

We have expended in construction during the three months $26,506.68, and have earned above all expenses and construction $40,179.55, which is at the rate of 3 34-100 per cent. on the issued capital.

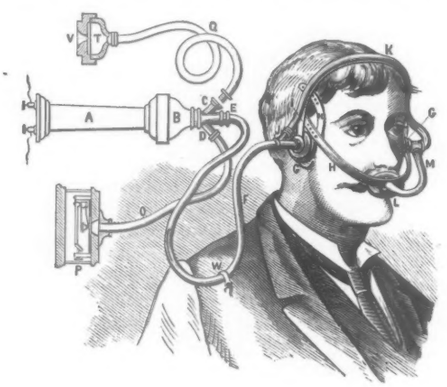
We have made a net gain of 325 subscribers, and have a total of 9,267 connected July 1, 1884.

CHARLES J. GLIDDEN, Treasurer.

*** A gentleman from Mexico, who is in the city, and who had not seen telephones in use until recently, was in the central office of the telephone company. He entered into conversation with the young ladies who manage the hello office, and was very much interested in the working of the mysterious instruments. He expressed a wish to see the office when a fire alarm was given. Just then, as if in answer to his wish, an alarm was turned in from the Third Ward. In an instant the keys were all thrown open and the fair operators were talking all at the same time with 150 places, giving the location of the fire. The Mexican visitor looked on in mute astonishment for a moment, and then, lifting his hat politely, said he believed he would go—he had seen enough. "Don't be in a hurry," said one of the young ladies, pausing a second. "Yes, I must go," he replied. "I have seen one business in which a woman can talk all she wants to, and I am now ready to die," and with a look of perfect contentment he took his departure.

A Novel Telephone Support.

Mr. N. G. Warth, manager of the telephone exchange at Canton, Ohio, has patented an ingenious device, a cut of which is given herewith. The receiving telephone, *A*, is of the ordinary construction, and is supported in a fixed position; it is provided with a mouthpiece extension, *B*, having three branch tubes, *D*, *C*, *E*, for receiving flexible tubes. A curved spring, *I*, of nearly semi-circular form, is jointed to a similar spring, *H*, and these two springs are kept in a fixed position in relation to each other by the



brace, *N*, which is made adjustable in order to adapt the apparatus to the heads of different users. Attached to the ends of the spring, *I*, are earpieces, *G*, provided with tubes, *F*, having branches, *J*. The tube, *F*, communicates with the central tube of the extension, *B*, on the receiving telephone, and the tube, *K*, communicates with the other earpiece, and a branch, *M*, communicates with the mouthpiece, *L*, secured to the center of the spring, *H*. By this means the earpieces and the mouthpiece are held in position for use. The branch, *D*, is connected with the transmitter, *P*; the branch, *C*, is connected with the earpiece, *T*, to enable a second person to listen.

Sounds produced by the receiver diaphragm are communicated to the ears through the tubes, *F*, *K*, and the earpieces; and speech uttered in the mouthpiece affects not only the transmitter through the tubes, *M*, *K*, *F*, and *O*, but also the receiver, which thus acts as a transmitter also and augments the volume of sound transmitted. To prevent the accidental jerking of the apparatus from the head, the tube, *F*, is attached to the clothing by a clasp pin. Concerning the practical use of this device, Mr. Warth writes: "We have two sets in use at the board and find that they are satisfactory in every way. Both ears being covered and in use, all the indistinct sounds of long-distance talking are received more readily than they would be otherwise. It also prevents talking or other noise in the immediate vicinity of an operator from disturbing her, and permits the free use of both hands in working. The apparatus being very light (weight, six ounces) does not tire nor inconvenience the operator in the least. She can talk and listen in whatever position she pleases while working."

Lightning Arresters for Electric Light Lines.

In examining several electric light installments the writer has been surprised to find no provision made to protect the apparatus and the buildings in which the light is used from damage by lightning; in fact, he has been told by more than one engaged in the construction of electric light plants, that there can be no danger, for the lines have no connection with the earth, and so the lightning will not seek but rather avoid them.

How general such opinion is among electric light men, and how few plants may be protected is not known to the writer. It may, however, be worth a little space in the ELECTRICAL REVIEW to attempt to show the importance of lightning arresters for electric light circuits.

It is true properly constructed light lines have no connection with the earth, but they are in many places relatively much nearer a good earth connection than at other points. They may, for instance, run for miles over high buildings, and then descend to a lamp in a building, and at the lamp, or in crossing the room, may come within a few feet, or even inches, of a gas or water pipe. In many places, in almost every building they enter, the wires run near some pipe, rod, or telephone wire; now, the lightning, in seeking a passage to the earth, will, at some high point, choose this large copper conductor, which is capable of conveying a very large quantity of the current, and leave the wire for some good earth conductor at a point where the least resistance is offered.

In one case, with which the writer is familiar, the dynamo machine, connected with an extended circuit about town, was bolted to the floor near the damp earth; the lightning came in on the wire and passed from the coils of the field magnet to the iron frame of the machine, and thence to the earth, seriously melting the wire of the dynamo.

In another instance, which occurred in the evening, the lightning passed from the wire to a gas fixture in a patron's place of business, at the same time so overcharging the line as to check the revolving armature of the dynamo, throwing off the belt and leaving for a time a part of the city in darkness. Probably a more extended inquiry would disclose similar or even more disastrous cases.

To remedy this, let each electric light circuit have, at the light station or at several places along the line, a good arrester, connected to the earth by a wire as large as itself. Of course the arresters should be well made and placed where moisture cannot get to them, as moisture or improper adjustment might cause danger by escape of the working current.

The "saw-tooth" arrester, made several inches long, and placed on slate or earthen base, with glass case, would be admirably suited to the want.

I. H. FARNHAM.

The Organization of the Post and Telegraph Service in France.

There was only one single cable belonging to the Government which connected France with Algiers, and this cable was laid in 1871. As this communication, however, was insufficient for the regular transmission of our messages, we were obliged to forward every day some 90 messages by one of the Marseilles-Bona cables, belonging to the Eastern Telegraph Company, and in consequence of this France had to pay an annual sum of about 80,000 francs.

Now, taking into account the fact, as proved by experience, that submarine cables last only a limited time, and that this cable laid in 1871 had already been in existence over seven years, we came to the conclusion that within a few years this communication might fail us altogether.

It became, therefore, urgent to proceed to the laying of a second cable, under penalty, in case of interruption of the only communication, to have to forward, over the cables of the Eastern Telegraph Company, the whole of the correspondence with our African territory; this, of course, would have been very onerous, and insufficeint for the service.

The law of the 12th of April, 1879, gave us the necessary means for the laying of a second cable between Marseilles and Algiers.

The laying of this cable was completed on the 11th October, 1879, its length being 917,666 meters. The immediate consequence of the establishment of this second cable was a considerable improvement in the service, as it enabled us to submit for your signature the decree reducing, from the 20th October, 1879, the price of telegrams between France and Algiers or Tunis, from 20 centimes to 10 centimes per word, with a minimum charge of one franc.

The number of Franco-Algerian telegrams for the term of the year, previous to the reduction of rates, was 202,394, producing a sum of 596,667 francs. During the term of the year immediately following this reduction the number of those telegrams reached 374,321, producing a sum of 623,480 francs. Since then, this increase has grown larger and larger; the number of private telegrams exchanged between France and Algiers, which, in 1877, amounted only to 118,663, has reached in 1883 a total of 540,752, or an increase of 442,089, equal to 356 per cent.

Because of this enormous increase in the traffic, we were compelled to ask the Chambers to vote us the necessary credit for the laying of a third cable.

A credit of 1,600,000 francs placed at our disposal enabled us to execute this important work. The adjudication took place on the 18th June, 1880, and the cable was laid, with complete success, on the 3d October, 1880, and opened to the public service on the 6th October.

We have further obtained from the Eastern Telegraph Company the renouncement of their privilege of free transmission through France of telegrams exchanged between England and the East, which had been granted to them by the convention of the 12th Aug., 1876; they now pay for those messages a transit price of 5 centimes per word.

This company has also undertaken to transmit over their Marseilles-Bona cables telegrams exchanged between France and Algiers or Tunis, at the rate of 5 centimes only, instead of 5½ centimes per word, whilst Government messages are allowed a reduction of one-half of the rates.

These modifications in the previous state of affairs represent to us a yearly increase in receipts of about 100,000 francs; they have been obtained without the Administration having had to make any sacrifice; the company have only reserved to themselves the right to recant these modifications, and to put the previous arrangements again into force, should, under certain conditions, a competition be established with the service of their lines.

Through the laying of the two cables to Algiers, or the cable to Corsica, of a cable between La Calle and Bizerta, of a cable between Bona and Bizerta, of a submarine communication between Soussa, Sfax, Gabes

Djerba, and Zarzis, and by laying some coast cables, our submarine system has been increased, in six years, from 1,324 kilometers to 4,534 kilometers, or by 535 kilometers per annum.

It should be observed here, that from 1871 to 1877 the submarine system had only been increased by 195 kilometers.

We also wish to recall to mind that on the 7th January, 1879, M. Pouyer Quertier, acting in the name of an anonymous company formed for the laying and working of submarine lines, has been authorized to land one or several trans-Atlantic cables, connecting France with North America. The first cable, laid by that company between Brest and New York, was completed on the 22d January, 1880, and opened to the traffic. The public has thereby gained a remarkable reduction in the price of telegrams exchanged with America; from 3 francs 75 centimes per word, the tariff has been considerably lowered, because of the competition between the English companies and the French company; it is at present 2 francs 50 centimes per word.

The telegraphic relations between France and America have thus been improved.

The company is a French one, and it rests with the Government to see that it remains French; this should be kept in view.

Previous to the concession for this cable, France did possess already an Atlantic cable between Brest and New York, originally conceded to a French company, but who had since sold their rights to an English company, the Anglo-American Telegraph Company, to whom belong the cables between England and the United States.

The Anglo-American Telegraph Company, for the transmission of messages for which no route is given, possess a right of preference at equal prices. This privilege expires on the first September, 1889.

A request for the concession of a third Atlantic cable has been made to us, and we may expect that another telegraphic communication will soon be established between France and America.

Senegal is not yet connected with the general telegraph system. This causes an unfavorable situation for that Colony, especially in its relations with France.

The Chambers, however, have voted a credit of 1,700,000 francs to fill up this gap, and have also approved of the contract made with the company, to whom belongs the cable from Cadiz to the Canary Islands, and who for that sum have undertaken to lay, to maintain, and to work, during 25 years, a cable from the Canary Islands to Senegal.

At the end of 25 years the cable becomes the property from the Administration; up to that date, although exempt of all costs of working and maintaining the cable, we receive a third of the amount of the rates between France and Senegal.

We have given our co-operation to the Ministry of Marine and Colonies for the laying of a submarine cable between Cochin-China and Tonquin, as authorized by the law of the 23d December, 1883

We were obliged to address ourselves for the establishment and the maintenance of this line to a foreign company—the Eastern Extension Telegraph Company. The cable, however, will be worked by officials of the French Telegraph Administration.

Unfortunately, we have not got in France a single company possessing a complete establishment for submarine telegraphy.

Besides, the Eastern Extension Telegraph Company, who possess several cables in the extreme East, alone were able to lay this cable at a cheap rate, the more so, as in order to be sure of its maintenance it is indispensable to keep on the spot ships specially fitted out to allow of the repair without delay of any accidents that might occur; should the ships required for such repairs have to be sent from Europe, the interruptions might last for several months.

A previous contract, dated the 11th July, 1883, had appeared to the Chambers to require alterations, and this delayed for a few months the date on which the cable was laid.

The laying of this cable will give cause to a yearly subvention of 265,000 francs during twenty years, to which sum should be added the cost of working it, estimated at 50,000 francs.

But the produce of the messages transmitted over the cable, and the reduction of one-half of the rates for all Government messages forwarded over all the cables belonging to the company, reduce the yearly expenses to 230,000 francs, of which amount Cochin-China will pay 115,000 francs as its share.

Besides the cables we have mentioned, our submarine system consists of ten other lines.

The cable from Marseilles to Barcelona connects us with Spain.

Another one from Calais to Fano secures our relations with Denmark.

The six cables which connect us with England are laid as follows: Two between Calais and Dover; the others from Boulogne to Folkestone, from Dieppe and Havre to Beachy Head, from Coutances to the Channel Islands, and to Plymouth.

Finally, two cables, from Poulizan to Salcombe, and from Deolin to Porthomme, are reserved for the transmission of telegrams from England, which have to be forwarded by the cables from Brest to New York, and *vice versa*. In case of interruption or insufficiency of the French cables, they allow our telegrams for the United States to be forwarded *via* England, without any extra charge.

The authorization to lay these several cables has been conceded according to the terms of contracts, unfortunately very different in their exigencies.

By a contract, dated the 2d January, 1859, and a subsequent contract of the 2d January, 1861, the privilege for the transmission of telegraph messages between France and England has been granted to the Submarine Telegraph Company. Consequently, the Government cannot lay any new cables between France and England before the 2d January, 1889, when the present concession expires.

The importance of the laying operations of the submarine cables, which we had to undertake, tended most particularly to call our attention to the conditions on which the Administration could obtain the necessary cables.

This industry, which is almost entirely in English hands, is not practiced in France but in a very restricted number of works. On the other hand, speculation has secured the trade in gutta-percha, a material essential to the manufacture of cables.

Because of the high price of this product, edulterated guttas are frequently made use of to the great detriment in the insulating qualities of the cables; in any case the quality is very variable. Finally, the risks of the laying operations are very considerable.

We were, therefore, of opinion that for large undertakings, such as the establishment of submarine lines between France and Algiers, it would be to the interest of the French Administration to make the contractor himself lay the cable which he had supplied; in this way we left to him the responsibility of any accidents that might occur during the laying.

The Administration further imposed upon him the obligation of a guarantee during a fixed period.

We proceeded on this principle to the adjudications for the two submarine lines which have thus been established between Marseilles and Algiers in September, 1879, and in October, 1880.

Each of those cables has been laid by the contractor; following a route selected by our engineers, who also pointed out the landing places.

Those cables, manufactured in the usual manner, answered to mechanical and electrical conditions which had been plainly determined by the specifications.

The contractor had further to supply the batteries as well as the testing and speaking instruments required at the two ends of the lines. That material has remained the property of the State.

The manufacture of the cables had been looked after at the works of the contractor by officials delegated for that purpose.

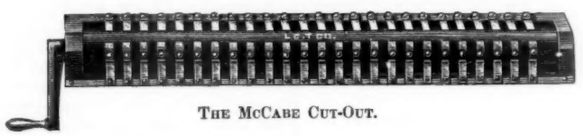
The costs of this control, as well as those for superintending the shipment, laying, and final acceptance of the cable had to be paid by the contractor. The amount of those expenses has been deducted from the sums due to him.

Although we have not had to interfere during the operations of the laying of the cables, our Administration was each time represented on board of the ships of the contractor by engineers, whose duty it was to see that the cable payed out did not contain any defective parts, and answered to the required electrical conditions.

After the laying our engineers have taken the necessary tests to assure themselves of the good working of the cables, and they accepted the lines, but with the reserves of the guarantee-times, fixed at six months from the date of the completion of the laying.

All these operations have been executed by an English firm, the India-Rubber, Gutta-Percha and Telegraph Works Company, of London. We could not get French firms to take part in the adjudications which took place.

Private industry, indeed, does not possess, in France, any complete establishment for submarine telegraphy. The precautions which it is indispensable to take for the preservation of the core of submarine cables, and the practical means to pay them out to the bottom of the sea, require that they should pass direct from the works into the tanks of the ships from which it is intended to lay them. Now, the two principal French firms fitted up for making cables, have their works near Paris, and, as they have neither staff or ships for the laying, they cannot undertake the work of establishing a submarine communication. They only supply ordinary subterranean cables for crossing towns, etc.—*London Electrical Review.*



THE MCCABE CUT-OUT.

The McCabe Cut-Out.

We give herewith a cut of the McCabe instantaneous telephone cut-out, which claims to be the most efficient protector against lightning ever offered to telephone companies. By its use every line in an office may be grounded in an instant, if judged necessary, upon the approach of a thunderstorm, and the entire telephone apparatus of a central office cut out of circuit until all danger of burning out the instruments is passed.

PEEKSKILL, March 22, 1884.

Benj. McCabe, Esq.

DEAR SIR: In answer to your inquiry as to how I like your lightning arrester, allow me to say that I have used it on the exchange here for the last two years with great results.

We started our exchange with a twenty-five Williams' board, and as our subscribers increased we added another twenty-five. With the first we had one of your arresters attached, and none on the other. A heavy thunderstorm came. The board with the arrester on was thrown out, and when thrown in contact, after the storm, it was in perfect order. The one without the arrester on had thirteen coils, or annunciators, burned out. Every one connected with the telegraph business knows what it is to have a "drop" not work. The subscriber growls and everything goes wrong until the coils are taken out, rewound and replaced. All this takes time; with your arrester this trouble is overcome.

A trial is all that is necessary for any one to find out its worth. In fact, the instrument speaks for itself.

I am, truly yours,

CHAS. R. SWAIN,
Manager Hudson River Telephone Exchange.

TELEGRAPHIC

.... The new Atlantic cable just laid has a resistance of 6,000 ohms and a capacity of 800 microfarads.

.... The Mutual Union Telegraph Company recently entered into an agreement with the City of Chicago to begin the work of laying some of its wires underground within fifteen days.

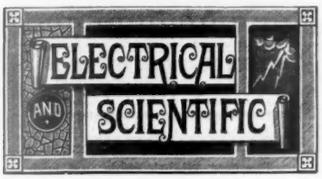
.... A contract was executed last week giving the Baltimore and Ohio Telegraph Company control of the wires on the New York, Ontario and Western Railway, between New York and Oswego, on and after August 6, on which day the Western Union contract expires. This will add about one hundred offices to the Baltimore and Ohio system.

.... The Connecticut District Telegraph and Electric Company, of Waterbury, Conn., have 250 district boxes in operation in Bridgeport and 160 in Meriden. They also have an excellent system of night watch connected with the district service. At Waterbury they have forty Thomson-Houston arc lights in operation. This, together with the manufacturing of electric gas-lighting apparatus, electric balls, etc., keeps Supt. Young and his score of assistants very busy. Mr. Young has within a short period built up an excellent business for this company.

.... The latest move of the Baltimore & Ohio Company is to cut down the rate for messages between St. Louis, Baltimore, Washington, Philadelphia and New York. It was 50 cents, and still stands at that figure over the Western Union system; but the Baltimore & Ohio has reduced the price to 40 cents. On Monday next the price will go down to 25 cents for day messages and 15 cents for 15 words at night. This is uniform with the recent reduction on a similar basis to the cities referred to. A few days following these reductions the new combination between the Baltimore & Ohio, Postal, and Bankers and Merchants' will go into effect.

.... Owing to the peculiarity of the Chinese characters, each of which represents a word, not a letter, as in our western tongues, the Danish Telegraph Company (the Great Northern) working the new Chinese lines have adopted the following device: There are from 5,000 to 6,000 characters or words in the ordinary Chinese language, and the company have provided a wooden block or type for each of these. On one end of this block the character is cut or stamped out, and on the other end is a number representing the character. The clerk receives a message in numbers, and takes the block of each number transmitted and stamps with the opposite end the proper Chinese character on the message form. Thus a Chinese message sent in figures is translated into Chinese characters again and forwarded to its destination. The sending clerk, of course, requires to know the numerical equivalent of the characters and have them found for him.

.... The special telegraphic reports of the proceedings of the last two National Conventions were unprecedented for their accuracy and completeness. For the four days of the Republican convention 1,660,178 words were telegraphed special through the Western Union office, an average of 415,000 words a day. During the four days of the Democratic convention 1,522,960 words were telegraphed special, or an average of over 380,000 words per day. The Baltimore & Ohio Telegraph Company, which also did excellent service at the conventions, sent about 70,000 words a day, and the other companies probably sent an amount equal to that. It is safe to assume that over 4,000,000 words of specials were telegraphed from Chicago during the eight days that both conventions were in session. Hundreds of thousands of words were telegraphed the few days preceding the assemblage of each of the conventions, and the revenues from specials to the telegraph companies during both convention weeks at the Chicago offices could not have been less than $50,000.



* * The electrical railway at Portrush, Ireland, has proved both a scientific and financial success.

* * According to figures just published, the Postmaster-General of New Zealand reports that at the close of 1882 the total number of telegraph stations connected by telephone was 66. The exchanges at Auckland, Christchurch and Dunedin had a total of 417 subscribers.

* * E. E. Blavier, the eminent French electrician, associates earth currents—which at times so powerfully affect telegraphic operations and the mariner's compass—with trade winds, and thereby indirectly with the sun. He favors De la Rivers' theory that the aurora borealis is due to the circulation of electric currents in the higher regions of the atmosphere.

* * According to the recent researches of M. Bouty, the neutral salts in very extended solutions of water form a group apart as regards their electric conductivity. For example, ethylic alcohol, glycerine, erythrite and phenol, glucose and candied sugar, ordinary ether and dichlorhydrine, ethylic aldehyde and acetone, as well as albumen, all conduct very badly. M. Bouty has also come to the conclusion, from his experiments, that an anhydrous alkali or acid is not a conductor, but that a hydrated acid or alkali conducts like a salt.

* * Señor Enrique R. Mexia has been delegated by the President of Mexico to represent that country at the International Electric Exhibition which opens in Philadelphia on September 2d. The buildings are now completed, and it is expected that some of the exhibits will be placed in position during the present week. Señor Mexia will also represent the Republic of Mexico at the national congress of electricians, which will convene some time during the progress of the exhibition.

* * A Canadian has invented an electric motor for illuminating railway carriages. It takes up very little space, and is driven by a pulley attached to the axle of the car. The difficulty hitherto existing in the use of electricity for illuminating railroad cars has been that when the train stopped the light would go out. The objection has been overcome by electricians, who are now able to store up the subtle fluid in cells for use when the generators are not at work. The new motor has been tried on the cars of the Grand Trunk Railroad.

* * At the last meeting of the London Physical Society for the present session, Lord Rayleigh, president-elect of the British Association, exhibited the platinum bowl voltameter which he has designed for measuring the strength of an electric current. This is the best means yet found for estimating the current in absolute measure. The platinum bowl is the cathode in his apparatus, the anode being a sheet of silver wrapped up in clean filter paper sealed round it. The filter paper is a sheath for the anode to catch any grains of silver which may be loosened from it in the act of decomposition, and prevents them from falling on the bottom of the bowl or cathode. The bowl is filled with a solution of silver salt, the pure nitrate or pure chlorate being preferred. Silver acetate ought not to be used, as it does not give such good results. The anode is dipped in the solution till the sheet is quite immersed, and the current turned on. One ampere deposits four grammes of silver in an hour; therefore a quarter to half-an-hour is sufficient to give one to two grammes—a quantity which can be weighed with sufficient accuracy in a chemical balance. Any current from $\frac{1}{10}$ to five amperes can be successfully measured in this way.—*Engineering.*

* * It is understood that the Patent Office has awarded Stephen D. Field of New York the priority of invention of the electro-dynamic motor, as against the adverse claims of Mr. Edison and Dr. Siemens. This is the motor which has been put in operation in Berlin for the propulsion of street cars. It is the intention to utilize this motor on a large scale on the elevated railroads of New York. It is claimed for the invention that it will not only dispense with the locomotive and its noise and smoke and cinders, but will furnish power at a greatly reduced cost for street travel, and for all railways where frequent trains of comparatively light weight are employed.

* * Since the introduction of Clark's electric launches, about a year ago, considerable improvement seems to have been effected in them. One of the first of a fleet of these small vessels, in course of construction to the order of a Munich firm for inland water service, was tried lately on the Forth and Clyde Canal, Scotland. She is twenty-five feet long by four feet ten inches beam, and weighs, with the charged batteries, about 840 pounds. The propeller is fifteen inches in diameter. During the trial a speed was developed and maintained of between five and six miles an hour. The engines, which worked noiselessly and without vibration, yielded 2.6 horse-power.

* * A new electric railroad went into operation in Cleveland, Ohio, in connection with the East Cleveland Street Railroad Company, which has just completed a mile road. The experiment was so successful that the company, it is said, expect to change their entire system, comprising over twenty miles, into electric roads. The system used was a combination of the Brush & Knight and Bentley systems, and the current was carried on underground conductors laid in conduits like those of cable roads. The cars were started and stopped and reversed with the greatest ease. Any number of cars up to fifteen can be run at one time on a single circuit and from machine, which is a result not obtained by any of the European systems now in operation.

* * The following gentlemen have been appointed by the President a commission to conduct a national conference of electricians in connection with the International Electrical Exhibition, which opens in Philadelphia September 2: Professor Henry A. Rowland, of Johns Hopkins University, Baltimore, Md.; Professor John Trowbridge, of Harvard University, Cambridge, Mass.; Professor George F. Barker, University of Pennsylvania, Philadelphia; Professor M. B. Snyder-High School Observatory, Philadelphia; Professor J. Willard Gibbs, Yale College; Professor Simon Newcomb, *Nautical Almanac* office, Washington, D. C.; Professor Edwin J. Houston, Central High School, Philadelphia; Professor Charles A. Young, Princeton College; Dr. William H. Wahl, secretary of the Franklin Institute, Philadelphia; Professor F. C. Vandyck, Rutgers College, New Brunswick; Professor C. F. Brackett, Princeton College.

* * Some time ago Professor Frankland suggested that in charging and discharging accumulators hexabasic sulphuric acid was electrolyzed. Dr. Gladstone and Mr. Tribe have carried out some experiments in this direction with sulphuric acid of a strength of 4.2 per cent. Their apparatus consisted of a U tube having a stop cock in the center of the horizontal portion. The hole in the stop cock was so packed with asbestos as to prevent mechanical mixing of the liquids in the two arms of the tube or endosmose. With currents of different strengths they notice that the increase of sulphuric acid in the positive compartment, per equivalent of hydrogen set free, decreased with the lowering of the current strength. In other experiments with sulphate of copper in one arm and sulphuric acid in the other, they found that the acid accumulated was largely in excess of the copper deposited, this being due to the unequal transference of the ions. From these results and those obtained by other experimenters, they conclude that the electrolytic method is incapable of determining whether dilute sulphuric acid, H_2SO_4, or a hydrate thereof, gives rise to the current; and moreover, from other experiments with copper and zinc sulphates, in which both arms of the U tube were filled with the same solution, they show that neither the composition nor even presence of a hydrated salt in aqueous solution can be determined by this method.

Electricity as a Motor.

The interest aroused by the trial the other day of the Cleveland Electric Street Railroad, the first put into operation for city passenger travel in America, is natural, and the degree of success claimed for it is not surprising. Nearly a year ago electric cars were moved through the crowded thoroughfares of Paris by the Power Storage Company of that city at the rate of nine miles an hour, on a level and of more than five on an ascent. A distance of thirty miles was accomplished by moving the car from one route to another in the French capital, often across several yards of trackless ground, and without accident or difficulty of any kind. The locomotion was effected by Faure-Sellon-Volckmar accumulators, fixed under the seats, and connected with a Siemens machine beneath the floor. Last November we had the less successful preliminary trials of the Daft motor on a Saratoga railroad.

The electric railway in Vienna dates back to the Electric Exhibition there, when a mile in three minutes was regularly made by the train. At Berlin the high level railway was at the same time operated by electricity. The small electric railway at Portrush derived interest from seeking its energy in a neighboring waterfall; while the invention of Desprez for transporting electrical force to great distances has been applied to a waterfall near Grenoble, which has worked, to the extent of seven horse-power, a printing press, a sand mill, and other machinery.

An electrical omnibus, also, has been tried with success in Paris, during the busiest hours of the day, and the heavy vehicle was handled and turned with facility. In some of the coal mines of Saxony electricity has for many months been employed, not only to draw trains of coal, but also to work a ventilating fan. Even a thermo-electric stove has been invented, as have also electric lights that can be used on railway cars, in spite of the vibrations and frequent shocks to which trains are exposed.

On the water, electricity as a motor has made no less rapid progress than on land. Last summer an electric boat was plying on the Danube canal, taking thirty or more passengers six miles an hour against the strong current and eighteen miles an hour with the stream. Two years ago a launch propelled by electricity was shown on the Thames, and the following year a boat of that character, forty feet long, attained a speed of eight miles an hour on the measured mile—this boat being the one, we believe, already spoken of as used on the Danube. Its trips were accomplished, of course, without smoke, or heat, or smell of oil, and also without noise of engines or vibration. As for the application of electricity to submarine torpedoes, it is now the subject of much study, attended with some success. Electric small arms have already been invented, and one such weapon was operated not long ago by Colonel Fosbery at London, before an assembly of army officers and others, by means of a small accumulator secreted under his waistcoat. The gun was the invention of Pieper of Liege, who has fired more than a hundred rounds with it in two minutes. We may yet see electricity revolutionizing the manufacture of small arms.

But there is special interest attaching to the use of electricity in transportation, because here an enormous element in modern life, affecting great populations at all times, is dealt with. Of course the matter must still be viewed as experimental, since only protracted tests fully determine those considerations of economy, convenience, and safety on which ultimate success depends. It is certainly noteworthy, however, that while various new motors, such as caloric, compressed air, coiled springs, and grip cables, have been under contemplation and trial for so many years as possible substitutes for horses in street railways, electricity has suddenly come to the front, threatening to supersede them all.—*New York Sun.*

An Electrical Testing Establishment.

Our contemporary, the *Engineer*, in an article under the above heading, has put forth a suggestion with which we heartily agree; it is that an establishment should be formed in which all kinds of electrical testing work can be carried out by inventors. At the present day there are numbers of men whose ideas, although good, remain dormant, or are turned in the wrong direction, simply from their inability to practically test them, on account of want of facilities for doing so. A new electric lamp is devised, for example, by an amateur, but to practically test it a powerful and steady electric current is required; as this is not available he tries the experiment with a few battery cells, and if he gets anything like a result he continues his experiments on the same lines, and when he has satisfied himself that all is right, he perhaps gets an introduction to an electric light establishment, and he now tries practically what he has only tried on a small scale, the result often, and in most cases, being that he finds he has gone on completely the wrong track, and that much of his labor is thrown away. In telegraphy, and especially submarine telegraphy, amateurs are especially liable to work astray, as they design their apparatus to work through an ordinary resistance, and then imagine that they have achieved a success, quite overlooking the fact that resistance is but one element that affects the working of telegraphic apparatus. Inductive retardation, which has quenched the ardor of more than one inventor, is not thought of, or, rather, is made light of. In a case like this, were an artificial cable available, the inventor could by a test at once see whether he was on the right road or not, and would be saved much trouble and disappointment. In an establishment of the kind it would be very necessary that the inventor should be able to carry on his experiments in the utmost privacy and without fear of disturbance; thus, as our contemporary points out, if he wishes to test an electric lamp "he would be assigned a dark room and two terminals, giving him whatever current and potential he might require. If he found that small changes were necessary a workshop would be available, and he would be saved the loss of time which might be incurred in removing his lamp and bringing it back again." No doubt work and experiments carried on in this way might at first to some extent diminish the demands for opinions and advice from professional experts, and, therefore, the latter might be opposed to the foundation of an establishment of the kind; but eventually the stimulus which the facilities must give to many workers will increase the demand for professional opinions, as without the latter no enterprise would be taken up by the public. —*London Electrical Review.*

The Broadway Electrical Road.

ANOTHER PLAN FOR THE RELIEF AND THE RESTORATION OF THE GREAT THOROUGHFARE.

A general committee of representatives of telegraph companies, electrical companies, telephone companies, and city and State officials has had under consideration for some time the problem of establishing a system of underground electrical communication that shall relieve the city streets of the labyrinth of poles and wires. The chairman of the business organization of this committee, Mr. Rowland R. Hazard, has evolved a plan which he thinks will not only accomplish the one object sought, but will also solve the problem of restoring and preserving Broadway. In an interview with a *Sun* reporter, Mr. Hazard gave his views as follows:

"Broadway is the most noted street in America, and it was for a time the handsomest street. It is now disfigured by poles of every size, height, and condition of decrepitude, by miles of wire following and crossing it at all angles. Its structures are

disfigured by gallows-like erections used for supporting the wires, and its pavement is a broken, ridged and unsightly expanse unfit for travel, and noisy enough to destroy the nerves of Spartans. Sky line and street line are alike disfigured, and the beauty of Broadway is simply a tradition.

"Travel has been diverted from it to parallel thoroughfares, to the detriment of its values. The result is that, notwithstanding the vast sums expended in the construction of fine buildings along its line, its comparative value has declined along with its beauty and convenience. Now it is proposed to cap the climax of confusion and ugliness by introducing surface railroads, either horse or cable, and, under the pretense of an improvement, to complete its destruction.

"Plausible lawyers, employed by clever promoters, have succeeded in obtaining the consent of some abettors to their scheme, partly, no doubt, by taking some of them into partial partnership, and partly because, after a long contest, objectors have, in desperation, abandoned all hope of saving or restoring Broadway.

"Broadway ought now to be dealt with as a scientific street. The advance in constructive art and in electrical science has placed within the resources of the engineer the means of dealing with the street so that it will become the most perfect street in the world. Occupying as it does the ridge of the island, it is free from the obstructions which exist in every other street, and can, with moderate cost, be changed into a smooth and silent surface, adapted to the wants of the ordinary metropolitan traffic. This can be done by means of an arcade requiring an excavation of only fifteen of sixteen feet, with electrical railways therein, having a capacity of transit equal to that of the Third and Ninth avenue elevated railways combined.

"The Broadway Underground Company might do this under its existing charter. Such obstructions as now exist, in the sewer pipes, water pipes, gas pipes, steam-heating pipes, pneumatic tubes, etc., would be placed in convenient galleries between the tunnel and the curb, accessible at every point for examination, connection, and repair, and avoiding the incessant tearing up of the pavement which constantly destroys the surface of the roadway at present. These side galleries could be entered by doors from the stations along the line.

"This disposition of Broadway would benefit everybody, would injure nobody, and would leave the surface free from disturbance of all sorts. In addition to this, a pavement, such as has been placed in Paris and London, could be used. It is a scientific pavement, composed of concrete and asphalt, resting upon buckle plates or arches, with wooden blocks properly prepared, which would compose a beautiful and noiseless street.

"New Yorkers are accustomed to regard the wood pavement with disfavor, because of the absolutely unscientific use to which wood has heretofore been put. Heretofore the street has been composed of wood, and has decayed rapidly, and broken down under the pressure of traffic. The modern wooden pavement is as solid as a rock, the wood bearing the same relation to it that a carpet does to a marble floor, removable whenever necessary at an extremely moderate cost.

"The requirements of such a road under Broadway are, first, absolute safety; second, enormous capacity; third, a cheerful and pleasant street. All these requisites will be realized in the electric railway. The roof of the tunnel would be supported by steel columns, forming panels about four feet wide, which could be filled with non-resonant material to secure comparative silence. The foundation could be of concrete, except under the columns, where it should be of granite. The carriages could be composed of steel, covered with non-resonant material similar to the panels composing the tunnel. The tunnels themselves are compressed under the law within eight feet eight inches. The center section of the tunnel could be occupied by express trains of seven carriages running at three-minute headway. The side tracks could be used by way trains of four carriages running at one-minute headway. The passage of these trains through the tunnel would operate to ventilate the tunnel by establishing a continuous current of air, each train acting as a piston in a cylinder.

"The stations could be approached by entrances from the sidewalk connecting by galleries across the street. It is obvious that any carriages constructed of this indestructible material, driven along such a way, and employing an electrical current, will introduce elements of safety and comfort and progress that will meet the emergency.

"The cost of this scientific street is less than that of any which has ever been devised. The minimum of excavation is obtained by putting the pipe chambers at the sides. The maximum of accommodation is reached, and the comparatively narrow tunnel secures the least possible displacement of the street, combined with absolute security and safety."—*The Sun.*

Electro-Metallurgy.

A good deal has been written on the subject of electro-metallurgy, but, at the same time, little practical work has resulted from it. From time to time we have a few patents taken out which relate more or less directly to electro-chemical processes and to means of reducing metallic ores, and spasmodic attempts have been made to work such processes, but the support which the schemes have received from the public has been very trifling, and, practically, failure has been the result. For a brief interval the brilliant and interesting experiments of the late Sir William Siemens on the smelting of metals by electricity promised to lead to some definite move being made, but up to the present time no further progress seems to have resulted in the matter. The most favorable field for operations seems to be in the direction of extracting metals from their ores, but, although several patents have been taken out for processes which are stated to effect the object in view, yet these processes have but rarely been worked. Considering the extremely depressed state of the metal market any method of avoiding the use of coal fuel for smelting purposes, and substituting electrical power generated by the forces of nature in its place, would seem to have a prospect of success, provided, of course, the new process were a cheap one. The fact that electro-extraction has not been practically applied, would seem to indicate that no margin of economy can be shown to exist, even if the process could effect what it claims to do. In electro-plating there appears but little scope for improvement, though methods of successfully depositing certain of the metals, and especially platinum, have yet to be discovered.—*London Electrical Review.*

Electrical Engineering Accomplishments.

The inventions and improvements in machinery for the application of electricity are numerous, and form in themselves a distinct literature which is destined to become very voluminous. Both English and American electricians are bestirring themselves, as scholars and inventors never before toiled, in order to dig out the most successful mechanical appliances for the use of this wonderful force in nature. Among the many machines that deserve mention is one recently built abroad for generating, regulating, measuring, recording, and integrating electrical currents. The cores and armature, of the Siemens and Gramme type, are constructed of fine soft wires of square sections wound spirally in co-axial circles with the successive strands mutually insulated by strong, thin paper ribbons. A voltaic battery just patented, consists of a zinc and carbon couple separated by a porous cell or diaphragm. The porous cells are made of clay, carbonaceous matter and sesquioxide of iron. In a second battery, constructed according to this invention, any metallic oxide capable of being peroxidized may be employed.

A new conductor of electricity just out is provided with a series of parallel grooves and protected by an insulating sheath. It is based on the principle that, the electric current passes along the surface of the wire and not through its substance, and that the insulating material operates to impede and diminish the force of the electrical current in its passage along the surface.

A recent railway safety signal consists of an upwardly inclined movable rail, so fixed as to act upon a lever attached to an engine and operating a whistle or brake.

A new electro-magnet is composed of a number of iron tubes forming cores, provided at both ends with discs with flat surfaces acting as poles of the magnet.

A new telephonic apparatus consists of two small electro-magnetic receivers, or two coils forming part of a single receiver, which combine with two galvanic batteries.

Another dynamo-electric machine makes the cores of its magnets of a number of thin bars secured together and highly magnetized. The neutral parts are pole pieces fixed to the ends and having cast-iron for end pieces. The coil of the armature is composed of copper plates. The core is in the form of a drum.

A new galvanic battery is formed in which cells are connected, near to the top and at the bottom with longitudinal pipes of glass or ebonite, leading one to a reservoir, and the other to a receiver. The reservoir supplies the cells by gravitation. The exciting liquid is pumped up. The pumps are actuated by an electro-motor and a well-balanced iron beam, connected at its extremities with the piston rods of the pumps and to one or more electro-magnets arranged on each side of, and immediately below the beam.

Another dynamo-electric machine is of the ring-disc type, built of a number of plates separated by non-conducting material. These are connected by brass, or other non-magnetic bolts passing through tubes or bushes of wood. The bushes and bolts pass thorough washers of mica.

In the way of fittings for electric lighting may be mentioned a contact maker, which consists of a quick-threaded screw, of some insulating material carrying on one end a metal disc which rotates with the screw, and coming in contact with two terminals carried by an insulated block, which is secured in a cylindrical metal casting, open at one end and provided at its opposite sides with hollow arms or extensions. The open end is closed by a cap through which the screw passes, and the screw is provided with a weighted lever so that the contact must be perfect or completely broken.

An Electric Tramway Car.

A practical test of a new system of applying electricity to the propulsion of tramway cars took place on Tuesday, at Carnbrook, Manchester, England. The system is that of Mr. Holroyd Smith, engineer, Halifax. In a field at Carnbrook tramway rails of the ordinary gauge and size had been laid, upon which a car capable of holding about twenty people was run, the motive force being electricity applied on Mr. Smith's system. The electricity was generated at the telegraph works of Messrs. Smith, Baker & Co., and was conveyed by stout wires to the conductor, which consists of two half tubes laid a few feet below the ground, in the middle of the track, and extending the whole length of the rails. Within the half tubes there moves a collector, consisting of small rollers, which are pressed by a spring against the sides of the tubes. The collector travels with the car, and conveys the electricity from the conductor to an ordinary electric motor fixed below the floor of the car. The electric motor is attached by a chain to the axle of the wheels, and works the car. There is an arrangement by which the electric current is taken through the wheels to the rails, which form the return circuit. The car as it moved along was perfectly under control. The electric power exerted to move the car when fully loaded was equal to about two and a-half horses. The trial was considered successful. It is stated that the cost of the system is about 2d. per car per mile traveled, which is understood to be much less than the cost of the horse system.

ELECTRIC LIGHT NEWS

—— Council Bluffs is now lit by electricity on the Thomson-Houston system, in connection with the Westinghouse automatic engine.

—— The Municipal Electric Light Company, of Brooklyn, has been incorporated by H. Blauvelt, C. E. Brown, Charles Cooper, James Watt Fleming and Robert Payne. Its capital is $250,000.

—— The electric lights at Bar Harbor, which blazed for the first time last Saturday night, will sadly interfere with the choice little flirtations *sui generis*. One young belle was heard to exclaim, in heartrending accents, "Electricity has spoiled our lives."

—— The arrangements have been completed between a syndicate of gentlemen in Detroit and the American Electric and Illuminating Company, of Boston, to build a 200-light station in Detroit, to be equipped with Thomson-Houston lights. Work will begin at once, and 100 lights will be in operation in the course of a few weeks.

* * One of the beauties of the Philadelphia Exhibition will be the great electric fountain, which, from a basin thirty feet across, and surrounded by banks of flowers, will throw up twelve jets of water, a skillfully devised arrangement forcing colored light along the curves of the falling streams, which, as they meet and break, will show the prismatic hues of the spectrum, while from the central column will rise three lofty jets like brilliant tropical flower sheaths. From time to time the lights in the vicinity are to be lowered to give full effect to this magnificent fountain with its varied colors.

—— Major L. B. Wright, of the American Electric and Illuminating Company of Boston, has just closed a contract for the construction by that company, of which he is general superintendent, of a 200-light central station in Detroit, Mich., which will start up with one hundred lights as soon as they can be put in. The Brush company, which is lighting a portion of the city very poorly by the tower system, fought the new company very sharply, but a syndicate of prominent capitalists took the matter in hand and arranged for the introduction of the American system here. This also carries with it a contract for a 100-light plant at Port Huron, Mich.

—— The Anglo-American Brush Electric Light Corporation have just supplied to the order of a Colonial Government, says the London *Electrician*, one of its D_2 100 light Victoria machines. The field magnets of this machine are wound on the system patented and devised by Captain P. Cardew, C. E., of Chatham, and consists in an arrangement whereby the dynamo can be used for working arc, incandescent, or search lights at will. By means of a simple switch-board placed on the machine it is possible to so connect up the coils of the magnet fields as to allow of four powerful arc lights being worked simultaneously; or if four be not required three, two or one may be worked in parallel. By this ingenious method of winding, the difficulty of working arc lamps in parallel economically has been surmounted; the arrangement at the same time permits of any of the arc lamps being worked independently of the others. By a simple alteration on the switch-board the machine can also be used for working a single powerful hand-regulated search light of 25,000 candles, suitable for naval or military purposes. As well as this, the machine will maintain 100 20 candle-power, 60 volt Victoria lamps, and being self-regulating, these lamps may be turned on and off at will in any required number, with attention being paid to the dynamo, the speed remaining practically constant. Further, by this novel winding of Captain Cardew's, it is possible, they claim, to work satisfactorily arc and incandescence in parallel simultaneously

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING JULY 29, 1884.

302,539 Automatic hydrometer apparatus; Gabriel A. Bobrick, Boston, Mass., assignor by mesne assignments to himself and Frederick N. Wales, Newton, Mass.

302,553 Electric arc lamp; Walter K. Freeman, Brooklyn, N. Y., assignor to the Monarch Electric Company, of New York.

302,554 Armature for dynamo-electric machines or motors; Walter K. Freeman, Brooklyn, N. Y, assignor to the Monarch Electric Company, New York. N. Y.

302,555 Armature for dynamo-electric machines or motors; Walter K. Freeman, Brooklyn, N. Y., assignor to the Monarch Electric Company, New York, N. Y.

302,556 Field of force magnet for dynamo-electric machines; Walter K. Freeman, Brooklyn, N. Y., assignor to the Monarch Electric Company, of New York, N. Y.

302,557 Armature winding for dynamo-electric machines; Walter K. Freeman, Brooklyn, N. Y., assignor to the Monarch Electric Company, of New York, N. Y.

302,596 Means for applying electric motors to cars; William F. Sheridan, Chicago, Ill.

302,623 Primary and secondary voltaic battery; Achilles De Khotinsky, Rotterdam, Netherlands.

302,627 Apparatus for winding armatures for dynamo-electric machines; W. Bancroft Expent, 14 Southwick street, Hyde Park, county of Middlesex, assignor to William Munton Bullevant, 72 Mark Lane, London, England.

302,673 Apparatus for electrical heating; John Scudamore Sellon, Hatton Garden, county of Middlesex, England.

302,793 Electric motor; Eli T. Starr, Philadelphia, Pa., assignor to the S. S. White Dental Manufacturing Company, same place.

302,821 Electric signal; Aaron D. Blodgett, Boston, and Henry D. Winton, Wellesley Hills, Mass., assignor to the Hall Railway Signal Company.

302,827 Process of making incandescents; Allessandro Cruto, Piossasco, Italy.

302,836 Photographers' electric retouching device; Jean François Geesbergen and Alfred Geruzet, Brussels, Belgium.

A printed copy of the specification and drawing of any patent to the annexed list, also of any patent issued since 1865, will be furnished by any of the patent solicitors whose advertisements appear in this journal. In ordering please state the number and date of the patent desired.

If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40.00. Various other Foreign patents may also be obtained.

Any of our readers having copies of the old REVIEW of the TELEGRAPH AND TELEPHONE, dated March 15th, 1882 (No. 3), not specially needed by them, will confer a great favor upon us by sending them to this office, for which we will remit twenty-five cents per copy.

DELANO & COMPANY,
23 Park Row, New York.

Box 3,329.

Neatly-bound volumes (half-yearly) of the ELECTRICAL REVIEW will be sent, postage prepaid, on receipt of $3; also the latest improved self-binders for the ELECTRICAL REVIEW, or any other electrical or scientific journal published in this country, for $1. Delano & Company, publishers, 23 Park Row, New York, N. Y.

EDWARD P. THOMPSON, M. E.,

Member, AMERICAN INSTITUTE ELECTRICAL ENGINEERS.
Member, AMERICAN SOCIETY of MECHANICAL ENGINEERS.

Expert & Patent Attorney.

Acts as attorney in applying for patents. Introduces them into manufacture. Examines and reports upon the validity and practicability of patents with experimental proof when required. Estimate of costs sent free. Electrical cases a specialty.

13 PARK ROW, NEW YORK.

BUSINESS NOTICES.

A. C. NORTHROP, Waterbury, Conn. Iron and Brass Machine Screws, Zinc in Sheets and Plate for Electrical Purposes, Parts for Telephone and Telegraph Instruments, Manufactured from Iron, Brass, Steel or Zinc.

A. G. DAY, Kerite Insulated Telegraph and Telephone Wire and Cables, Anti-induction Kerite Telephone Cables. CLARKE B. HOTCHKISS, New York. Send for circular and prices.

ALFRED F. MOORE, Philadelphia, Pa. Telegraph, Telephone, Electric Light, Office, Line and Annunciator Wire.

AMERICAN BELL TELEPHONE Co., Boston, Mass. Electric Speaking Telephones for Exchange Systems, Private Lines, and Speaking-tube Lines.

AMERICAN ELECTRICAL WORKS, Providence, R. I. Patent Finished Insulated Electric Wires, Telephone and Electric Cordage. Electric Light Wire, Magnet Wire, Patent Rubber covered Wire, Aerial and Underground Cables, &c., &c. Send for prices.

AMERICAN INSULATOR COMPANY, New York. Insulators of all sizes.

AMERICAN SPIRAL TELEPHONE WIRE Co., Boston, Mass. Spiral Telephone Wire for long and short distance Telephoning. Write for information.

ARMINGTON & SIMS, Providence, R. I. Engines for Electric Lighting and general use.

AUSTIN GALLAGHER, New York. Keith Electric Light System complete for Arc Lighting. Stock for sale.

BAXTER ELECTRIC LIGHT COMPANY, New York. The Baxter Lamp.

A. M. YOUNG, Waterbury, Conn., Leclanche Zincs. Old style of rod with new connection.

B. W. PAYNE & SONS, Corning, N. Y. The Payne Single and Double Valve Automatic Engine. Send for catalogue.

BERGMAN & Co., New York. The Bergman and Haid Battery for Telephone and Telegraph purposes. Send for circular.

BOULTON CARBON Co., Cleveland, Ohio. Carbons for Electric Light purposes. Send for quotations.

BROWNLEE & Co., Detroit, Mich. Telegraph and Telephone Poles.

BRUSH ELECTRIC Co., Cleveland, Ohio. Arc Lights and Brush Storage Batteries.

BUFFALO ELECTRIC WORKS, Buffalo, N. Y. Carbon Points and Plates.

BUTLER HARD RUBBER COMPANY, New York. Rubber Insulators and Electrical Supplies of every description.

C. H. MOORE & Co., Washington, D. C. Solicitors of American and Foreign Patents.

C. P. WHITNEY, New York. General Eastern Agent of the Detroit Iron Tower Company. Towers and Arches, for Park and Street Lighting.

CHARLES WILLIAMS, JR., Boston, Mass. Call Bells, Electric Bells, District Bells, Switch Boards, Annunciators, &c., &c. Write for quotations.

CHROME STEEL WORKS, Brooklyn, N. Y. Steel for Magnets a specialty; Chrome Cast Steel.

COE BRASS Co., Torrington, Conn. Brass, Copper and German Silver in every variety of Sheets, Rolls, Plates, Wire, Rods and Blanks or Shells. Pure Lake Superior Copper Wire and Battery Zincs. Write for price list.

CONNOLLY BROTHERS, New York, Patent Attorneys and Solicitors.

CORNELL UNIVERSITY, Ithaca, N. Y. Electrical Engineering.

DETROIT ELECTRIC COMPANY, Detroit, Mich., white oak Pins and Brackets.

D. VAN NOSTRAND, New York. Scientific Books. Send for circular.

F. E. KINSMAN & Co., New York. Imported and Experimental Apparatus, Geisler Tubes, Motors, Coils, Lanterns, etc.

HARVEY, STAFFORD & Co., Acton, Ont., Canada Telegraph and Telephone Poles.

H. M. RAYNOR, New York. Platinum for all purposes.

HOLMES, BOOTH & HAYDENS, New York. Fireproof Electric Light Wire, Patent "KK" Insulated Copper and Iron Wire for Telephone and Telegraph use. Send for catalogue and prices.

I. W. COLBURN & Co., Fitchburg, Mass. Dynamo Electric Machines.

J. O. SHIRAS, Cincinnati, O. Telephone Stocks bought and sold.

JARVIS ENGINEERING COMPANY, Boston, Mass. Boilers set with the Jarvis Patent Furnace.

LECLANCHE BATTERY COMPANY, New York. The Great Telephone Battery. Write for description and prices.

J. H. BUNNELL & Co., New York. The Morse Learner's Instrument, Telegraph Instruments of all kinds, Telephone and Telegraph Supplies, Illustrated Works on Electrical Measurement, and the Galvanometer and its uses. Send for catalogue.

LAW TELEGRAPH Co., New York. The Law Battery for Telephone and Telegraph purposes.

MITCHELL, VANCE & Co., New York, manufacturers of Electroliers and Combination Fixtures, for both gas and electric light.

MONARCH ELECTRIC COMPANY, New York. Electric Motors, Dynamo Machines, etc.

NATIONAL ELECTRIC COMPANY, Washington, D. C. Electrical supplies and apparatus.

NEW ENGLAND BUTT COMPANY, Providence, R. I. Braiding Machinery for covering Telegraph, Telephone and Electric Light Wire, Single and Double Winders and Braiders of every description; also Fine Castings. Send for catalogue.

O. W. MADDAUS, New York. Designer and Engraver.

PAINE & LADD, Washington, D. C. Attorneys in Patent Causes, and Solicitors of Patents.

PALMER WIRE Co., Palmer, Mass., and New York. Galvanized Telephone and Telegraph Wire Iron and Steel Wire of best quality, Material, finish and conductivity. Write for quotations.

PARTRICK & CARTER, Philadelphia, Pa. Electric Annunciators, Learners' Instruments, Batteries and Telegraph and Telephone Supplies. Write for circulars.

PHOSPHOR BRONZE SMELTING Co., Philadelphia, Pa. Telephone Wire, insulated and bare.

ROYCE & MAREAN, Washington, D. C. Dealers in Electrical apparatus, Telegraph and Telephone supplies.

RHODE ISLAND TELEPHONE & ELECTRIC Co., Providence, R. I. Manufacturers of the Providence Telephone Switch Boards, Breckenridge Jacks, Wright Cable Clips, Howard Safety Appliances, &c.

SCHLEICHER, SCHUMM & Co., Philadelphia, Pa. Manufacturers of the Otto Gas Engine. Write for catalogue.

LAURENCE & HERKNER, New York. Manufacturers of Leather Belting for Electric Lighting. Send for catalogue.

CLARK INSULATED WIRE COMPANY, Philadelphia, Pa. Rubber and Braided Wire, for telegraph, telephone, and electric light use.

THE FREEMAN & ROE ELECTRICAL SUPPLY COMPANY, New York. Electric Light Machines, Motors, Dynamos, Telegraph and Telephone Apparatus.

SWAN INCANDESCENT ELECTRIC LIGHT Co., New York. Incandescent Lights, and Complete Apparatus. Send for illustrated catalogue.

THE ANSONIA BRASS AND COPPER Co., New York Pure Electric Copper Wire for Magnets, Telephone Lines, and Electric Light purposes, Office Wire, Zinc Rods and Battery Copper.

THE BISHOP GUTTA PERCHA WORKS, New York, Gutta Percha Insulated Submarine Telegraph Cable Subterranean Telegraph Cables, Aerial Telegraph Cables, Lead or Hempen covered Torpedo Cables, Lead-covered Cables, Telephone Cables of all kinds —G. P. Office Wire, and Marks' Compound Insulated Wire, &c., &c. Send for catalogue.

THE BUTLER HARD RUBBER COMPANY, New York. Electrical supplies, Rubber Hook Insulators, Hardwood Tubes, Plug Handles, Lamp Switch Handles, Battery Syringes, etc.

T. H. ALEXANDER, Washington, D. C., Solicitor and Counselor in Patent cases.

THOMSON-HOUSTON ELECTRIC Co., Boston, Mass. Automatic Self-regulating System of Arc Lighting.

THE ELECTRICAL SUPPLY Co., New York. Electric Light, Telephone and Telegraph Supplies. Send for price list and catalogue

TRENTON IRON Co., Trenton, New Jersey. Galvanized Iron and Steel Wire of all kinds for Telephone and Telegraph purposes. Write for prices.

UNITED STATES ELECTRIC LIGHT Co., New York. Arc and Incandescent Lights, complete and reliable systems, &c. Write for information.

VIADUCT MANUFACTURING COMPANY, Baltimore, Md. Electrical Goods of every description. Electric Light and American District supplies. Send for price-list.

VICTOR, BISHOP & Co., New York. Platinum for all Manufacturing, Chemical and Electrical purposes. Send for prices.

W. H. EARTHMAN & Co., Murfreesboro, Tenn., Red Cedar Poles. Write for prices.

WESTERN ELECTRIC Co., New York, Boston, and Chicago. Telegraph and Telephone Apparatus and Supplies of every description. Send for catalogue.

WM. A. HARRIS, Providence, R. I. The Harris-Corliss Steam Engines and Light and Heavy Castings.

W. R. POPE & Co., Baltimore, Md. Telegraph, Telephone, and Electric Light supplies. The best of everything, and at lowest prices.

WILLIAM KLINE, Toledo, O. Patent Portable and Adjustable Cross-Arm Holder.

DETROIT IRON TOWER CO.

Towers AND Arches

FOR PARK AND STREET LIGHTING.

The sure means by which illuminating is done better and cheaper than by gas.

One tower will supersede several hundred gas lights, by the use of three to six 2000 candle power lights at 125 to 175 feet high. Of the many in use, not one has failed to give satisfaction, nor have they been injured by the fiercest storms.

They are of many styles and highly ornamental as well as cheap.

C. P. WHITNEY, GENERAL Eastern Agent.
853 BROADWAY, N. Y.

Electric Lighting

The MASSACHUSETTS CHARITABLE MECHANICS ASSOCIATION will receive PROPOSALS for LIGHTING their EXHIBITION BUILDING by 100 or more arc lights during the Fiftieth Exhibition, September and October next. They reserve the right to reject any proposals.

Apply in person or address

A. H. BERRY,
Superintendent,
MECHANICS' BUILDING,
Huntington Avenue, Boston, Mass.

HELLO!
BOWEN'S NEW
Universal Telephone
FOR PRIVATE BUSINESS LINES.

Transmits speech in the CLEAREST NATURAL tone of any mechanical telephone ever offered.

The most practical and durable telephone for all independent lines. Contains latest improvements. Superior to others now in use. Business can be transacted through the line when the wind blows hard. Is self-contained, and has Magneto Call Bells, Lightning Arrester, Cut-out Switch, etc. Requires no battery. Placed in handsome walnut cases with nickel trimmings. Unequaled for connecting general offices with different departments, freight depots, etc.; also for factories, shops, lumber and coal yards, offices to residences, mills, furnaces, coal mines, etc. *Sold outright at reasonable prices.*

Circulars free. Mention this paper.

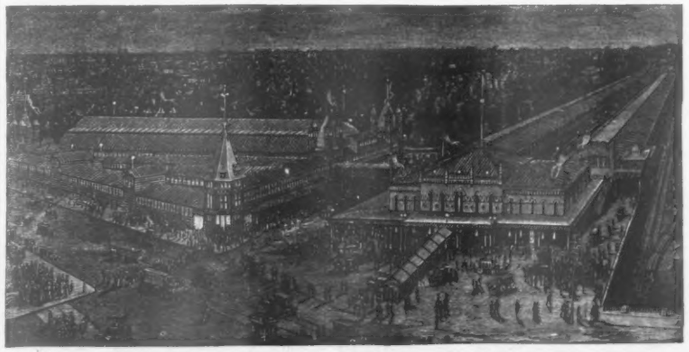
WM. J. BOWEN,
Manufacturer and Sole Proprietor,
NORWALK, OHIO.

PAINE & LADD,
LEMUEL E. PAINE, Late Commissioner of Patents. STORY B. LADD.
Attorneys in Patent Causes
And Solicitors of Patents,
WASHINGTON, D.C.

CONNOLLY BROS.,
Patent Attorneys
AND SOLICITORS,
MORSE BUILDING,
Cor. Nassau & Beekman Streets,
NEW YORK.
PHILADELPHIA, PA.,
Mutual Life Insurance Building,
10th AND CHESTNUT STREETS.
WASHINGTON, D. C.
CORNER 6th and F STREETS.

ELECTRICAL CASES A SPECIALTY.

Telephone Stocks
BOUGHT AND SOLD BY
J. O. SHIRAS, No. 11 West Third St., Cincinnati, O.



INTERNATIONAL ELECTRICAL EXHIBITION.
FRANKLIN INSTITUTE, PHILADELPHIA, PA.
1884 OPENS, SEPTEMPER 2nd. CLOSES, OCTOBER 11th 1884.

The Electric Gas Lighting Company
OF BOSTON, MASS.

Sole patentees and manufacturers of Standard Electric Gas Burners, has in stock a full line of apparatus, including several entirely new and elegant styles of burners, which are being sold at reasonable prices.

This apparatus is used with great acceptance in the leading cities of this country and Europe, and is the *first* and *only* practical system of lighting gas by means of the primary current of electricity, ever devised.

Our Electric Gas Burners are broadly covered by U. S. Letters Patent, and all persons manufacturing, selling or using such burners without authority from this Company *are infringers*, and will be dealt with accordingly.

Correspondence solicited. All applications for price lists, descriptive circulars, etc., should be addressed to

LOUIS W. BURNHAM, *President and Business Manager.*

THE ELECTRIC GAS LIGHTING COMPANY,
45 MILK STREET, BOSTON, MASS.

THE BRUSH ELECTRIC Co., CLEVELAND, OHIO.

The Sole Manufacturers under all the Patents of CHAS. F. BRUSH for
ELECTRIC LIGHTING, STORAGE BATTERIES, ETC.
We furnish the only complete and PERFECT SYSTEM of electric lighting.
THE BEST DYNAMO MACHINES.
THE BEST ARC LAMPS.
The Only Practical Storage Batteries.
The Purest and Best Carbons, &c.
Our prices are the lowest, our factory the largest and our business the most extensive in the world to-day.
Price, Single Lamps $50.00, Double Lamps $60.00.
SEND FOR DETAILS.
THE BRUSH ELECTRIC CO.,
No. 104 EUCLID AVE., CLEVELAND, OHIO.

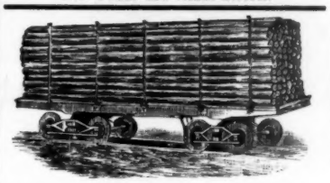
Electric Light Machines.
STANDARD SIZES.

No. of Mch.	No. of Lights 2,000 c. p.	No. of Lights 1,200 c. p.	Horse Power Required	Price.
2	1	2	1¼	$300.00
2			1½	300.00
3	2		3	415.00
3		3	3	415.00
4	4		4	565.00
4		6	4	565.00
5	10		8	900.00
5		15	8	900.00
6	20		14	1,500.00
6		30	14	1,500.00
7	30		22	2,000.00
7		45	22	2,000.00
8	65		45	3,600.00

INCANDESCENT LIGHTS

SWAN INCANDESCENT ELECTRIC LIGHT CO.
OWNERS OF THE
SWAN PATENTS FOR THE UNITED STATES,
ARE PREPARED TO GRANT LICENSES TO COMPANIES TO SELL AND USE THE SWAN INCANDESCENT LAMP, INCLUDING OUR PATENTED HOLDERS, SWITCHES, CUT-OFFS, ETC. WE GUARANTEE OUR LAMP AND TO DEFEND THE VALIDITY OF OUR PATENTS. FOR TERMS OR INFORMATION, APPLY TO
THE SWAN INCANDESCENT ELECTRIC LIGHT CO.,
853 Broadway, Cor. 14th Street, New York

HUGO KAYSER,
Manufacturer of
Electrical Instruments
AND
LIGHT MACHINERY.
EXPERIMENTAL WORK and MODELS
A SPECIALTY.
12 ELM STREET, NEW YORK,
Bet. Duane and Reade Streets.



RED CEDAR POLES,

THE MOST DURABLE IN USE.
For Prices and Estimates apply to
W. B. EARTHMAN & CO.
MURFREESBORO,
Rutherford Co., Tenn.

THE BUTLER HARD RUBBER CO.,
33 MERCER STREET, NEW YORK,
Manufacturers of
HARD RUBBER,
Sheets, Rods, Tubing, etc.,
ELECTRICAL SUPPLIES
Rubber Hook Insulators,
Window Tubes with Heads,
Key Knobs, Switch Handles,
Plug Handles, Lamp Switch Handles,
Battery Syringes, etc., etc.
Specialties of any PRACTICABLE CHARACTER made to order.

LAURENCE & HERKNER,
Manufacturers of
SPECIAL
Leather Belting
—FOR—
ELECTRIC LIGHTING.
Pure Oak Tanned.
Factory and Salesroom,
8 FERRY STREET, NEW YORK.
☞ Estimates made and full particulars furnished on application as above, personally or by mail.

THE CLARK
INSULATED ELECTRIC
WIRE COMPANY,
LIMITED.
Rubber and Braided Wire.
BRAIDED OR ARMORED CABLES
of every descripton for
Telegraph, Telephone, Electric Light and Signal Work.
Send for Prices.
J. CHESTER WILSON, Gen'l Manager.
419 WALNUT ST., PHILADELPHIA.

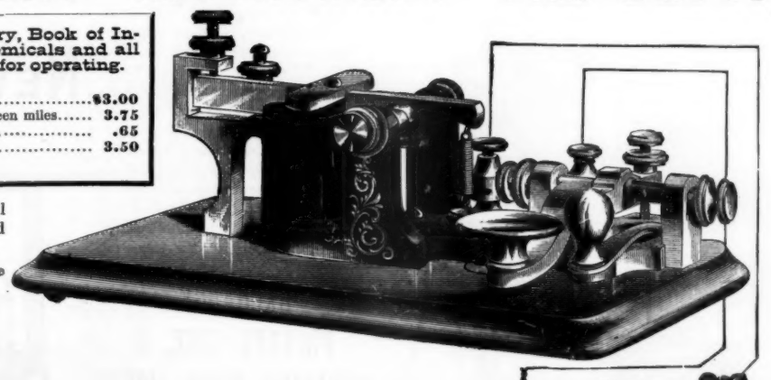
T. H. ALEXANDER,
Solicitor and Counsellor in Patent Cases,
607 7th St., Washington, D. C.,
OPPOSITE PATENT OFFICE.
Twenty-three Years' Practice.
Expert examinations and opinions, relating to infringements, Validity and Scope of Patents, Caveats, Designs, Trade-Marks, European and Canadian Patents. For information on Patent matters, send stamp for my "HINTS TO INVENTORS."

THE "MORSE" LEARNERS' INSTRUMENT THE BEST.

Price $3.75 complete with Battery, Book of Instruction, Wire, Chemicals and all necessary materials for operating.

"Morse" Instrument alone, without battery	$3.00
"Morse" Instrument without battery, and wound with fine wire for lines of one to fifteen miles	3.75
Cell of battery complete	.65
"Morse Learners' Instrument without battery, sent by mail	3.50

(Battery cannot be sent by mail.)



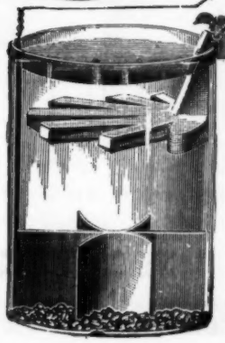
☞ Goods sent C. O. D. to all points if one-third of the amount of the bill is sent with the order. Remit by Draft, Postal Money Order, or Registered Letter. Favorable arrangements made with Agents everywhere.

☞ We will in every case refund any remittance made us for these goods, if they are not found to be entirely satisfactory.

You are sure of getting the BEST THAT IS MADE if you select the "MORSE."

The "Morse" is a full size, well made, complete MORSE TELEGRAPH APPARATUS, of the latest and best form for learners, including handsome Giant Sounder and Curved Key, and a large Cell of the best Gravity Battery, latest form.

IT IS THE BEST WORKING SET OF LEARNERS' INSTRUMENTS FOR SHORT OR LONG LINES, FROM A FEW FEET UP TO TWENTY MILES IN LENGTH, YET OFFERED.



J. H. BUNNELL & CO.,
No. 112 Liberty Street, New York.

BOULTON CARBONS

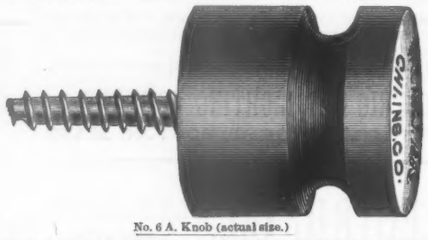
These carbons are made of the
BEST MATERIALS,
and with the latest improved machinery, of **any required degree of hardness,** and can be used in all makes of Electric Lamps.
The regular sizes, 12 inches long, run from ¼ inch to 1 inch in diameter, varying by sixteenths.
Special LENGHTS and SIZES to Order.
A large and complete stock always on hand.
The want of a high order of battery plate has long been felt. Those wishing such would do well to use the
BOULTON PLATES.
Special attention is given to the manufacture of all sizes to order.
Price Lists and full information furnished on application.

BOULTON CARBON WORKS,
PAYNE AVENUE,
CLEVELAND, O.

The Fiske & Mott High Resistance Insulator.

"Regular" (20 oz.)

Practical tests, in actual use, of these **INSULATORS,** since their introduction in February last, warrant us in guaranteeing for them a superiority of insulation, of from 100 to 300 per cent. over all others, and has demonstrated the correctness of the principle involved in their construction, viz., that of attacking the evil of leakage at its root—by PREVENTING THE ESCAPE OF THE CURRENT FROM THE WIRE to the insulator—and thus rendering unnecessary all appliances aiming to lessen the leakage FROM THE INSULATOR to its supporting pin.
While they are the most **EFFICIENT,** they are at the same time the **STRONGEST,** best made, and all things considered, the cheapest glass **INSULATOR** in the market. They are now in use by Telegraph, Telephone and Electric Light Companies in all parts of the country and must eventually supersede all others where high insulation is required.
Price of "Regular" 6 cents, and of "Pony" 3 cents, f. o. b. at Chicago, Detroit, New York, Philadelphia, or Baltimore—with special discounts on large orders.



No. 6 A. Knob (actual size.)

"Pony" (11 oz.)

Samples of any of our goods sent on application. Correspondence invited.

In our Patent Screwknob—the Screw is cast solid in the knob, and in addition to their convenience in putting up, are superior in insulation, when wet, to either glass or porcelain.
Our Combination Hook is made with or without cup. It contains no rubber and will not deteriorate by exposure to the weather. Price of Knobs, No. 5 A. (2 inches,) $4.50 per hundred; Price of Knobs, No. 6 A. (1⅝ inches,) $3.00 per hundred; Price of Combination Hook, $10.00, all f. o. b. at Chicago—with liberal trade discount.

THE CHICAGO INSULATING CO.,
122 La Salle Street,
CHICAGO, ILLINOIS.

ИЛЛЮСТРИРОВАННЫЕ КАТАЛОГИ
EXECUTED
IN FIRST CLASS STYLE AND WITH DESPATCH
O.W. MADDAUS
DESIGNER AND ENGRAVER ON WOOD
23 PARK ROW NEW YORK

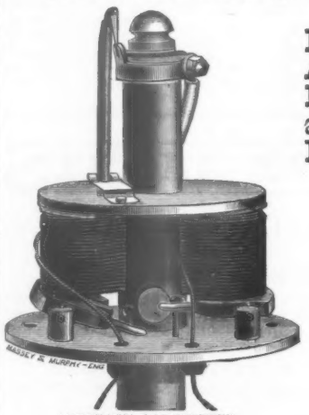
SPENCERIAN INK
Extra Black, Blue Black, and Copying, all of superior quality, claiming **Special excellence** in the essentials of **Fluidity, Color** and **Durability.** Circulars free.
Ivison, Blakeman, Taylor & Co., N. Y.

Leclanché Zincs.
PATENT
SPRING CONNECTION.

ZINC RODS
of all descriptions will be supplied the trade at lowest rates.

A. M. YOUNG,
Waterbury, Conn.

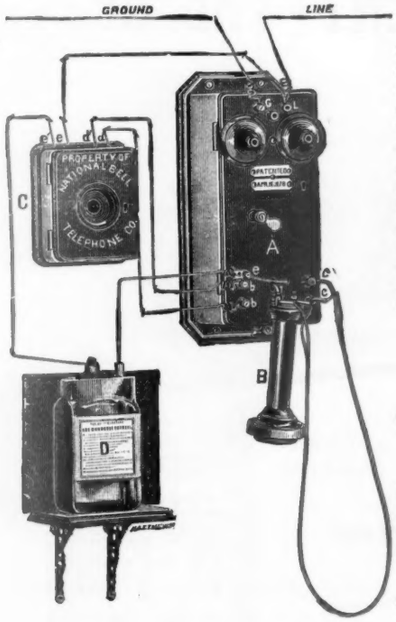
BOSTON ELECTRIC CO.,
550 WASHINGTON ST., BOSTON, MASS.,
MANUFACTURERS OF
Electrical Apparatus, Hotel Annunciators, Electric Bells, Burglar Alarms, Electric Light and Telephone Supplies, and Electric Gas Lighting Devices.


AUTOMATIC GAS LIGHTER.
Practical in every particular and perfectly reliable.

IMPROVED
CIRCULAR BASE BELL
Price, $1.75.

THE
American Bell Telephone Co.

WM. H. FORBES, *President.* THEO. N. VAIL, *Gen'l Manager.* WM. R. DRIVER, *Treasurer.*



This Company owns the Original Patents of Alexander Graham Bell for the Elcctric Speaking Telephone, and other patents, covering improvements upon the same, and controls, except for certain limited territory, under an arrangement with the Western Union Telegraph Co., the Gold and Stock Telegraph Co., the American Speaking Telephone Co., and the Harmonic Telegraph Co., the Patents owned by those Companies, and is prepared to furnish telephones to the citizens of the United States through its local Licensees, on the following systems:

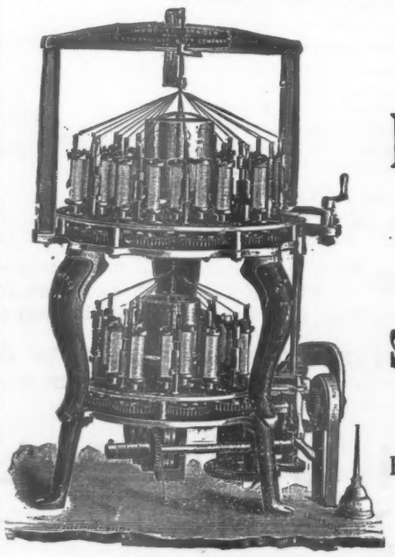
EXCHANGE,
PRIVATE LINE, &
SPEAKING TUBE LINES

Those desiring instruments on Private or Speaking Tube Lines, or connections on Exchanges, will please apply to the nearest Licensed Exchange, when their case will be brought to the attention of the proper local Company.
Any further information will be gladly furnished on application to the Company at its office,

No. 95 MILK STREET, BOSTON, MASS.

All persons using telephones not licensed by this Company, are hereby respectfully notified, that they are liable to prosecution, and for damages for infringement, and will be prosecuted according to the full extent of the law.

NEW ENGLAND BUTT CO.
PROVIDENCE, R. I.
MANUFACTURERS OF
BRAIDING MACHINERY
FOR COVERING
Telegraph, Telephone and Electric Light Wire
ALSO
SINGLE AND DOUBLE WINDERS
AND
Braiders of every description,
For Silk, Worsted and Cotton Braid.



FINE CASTINGS
A SPECIALTY.

The Coe Brass Mfg. Co.

MANUFACTURERS OF

BRASS,

Copper & German Silver,

IN EVERY VARIETY OF

SHEETS, ROLLS, PLATES, WIRE, RODS & BLANKS OR SHELLS,

Pure Lake Superior Copper Wire

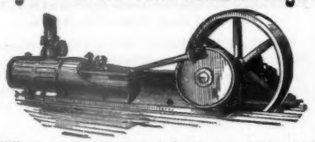
A SPECIALTY,

BATTERY ZINCS.

TORRINGTON, Litchfield Co., CONN., U. S. A.

THE PAYNE

Single and Double Valve Automatic Engine.



Will guarantee 20 per cent. better regulation with our *single slide valve automatic engine* than can be attained by any other engine in the market. For sale by E. P. Hampon & Co., 36 Cortlandt St., N.Y., Hill, Clark & Co., Boston, Mass. Write for Circular No. 36. B.W. Payne & Sons. Box 1450, Corning, N.Y.

MAGNET STEEL

AND ALL KINDS OF

CHROME CAST STEEL.

STEEL for MAGNETS

A SPECIALTY,

And warranted superior to all other brands.

CHROME STEEL WORKS,

Brooklyn, E. D., N. Y.

S. H. KOHN, *Proprietor.* C. P. HAUCHIAN, *Superintendent.*

CHARLES WILLIAMS, JR.

[Established 1856.]

Nos. 109-115 COURT ST., BOSTON, MASS.

AUTHORIZED MANUFACTURER OF

THE AMERICAN

BELL TELEPHONE CO.

Magneto, Crank and Push Button

GALL BELLS,

ELECTRIC BELLS,

DISTRICT BELLS

AND

Switches for Exchanges, Annunciators, &c.

Telegraph and Electrical Instruments, Batteries, Wire, Insulators, and Telephone Supplies of every description.

JARVIS ENGINEERING CO.,

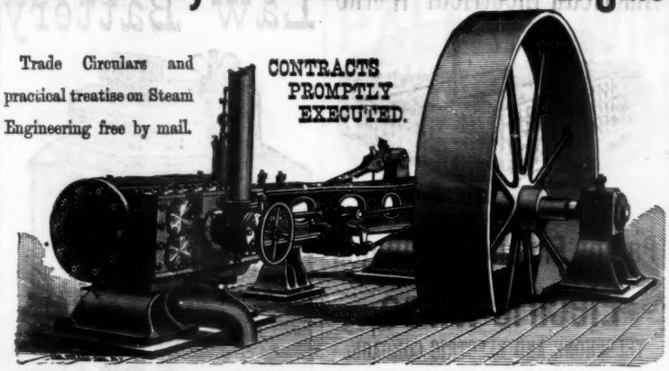
BOSTON.

Boilers Set with the Jarvis Patent Furnace to burn Pea Coal, Screenings or Slack without a blower. Send for Circulars.

The Buckeye Automatic Cut-Off Engine

Trade Circulars and practical treatise on Steam Engineering free by mail.

CONTRACTS PROMPTLY EXECUTED.



These engines are carefully constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable economy in consumption of steam, and superior regulation guaranteed.

Address, BUCKEYE ENGINE CO., Salem, Ohio; or GEO. A. BARNARD, Eastern Sales Agent, Astor House, N. Y. D. L. DAVIS, Sales Agent, 23 S. Canal Street, Chicago, Ill.

HARRIS-CORLISS STEAM ENGINE

BUILT BY

WILLIAM A. HARRIS,

PROVIDENCE, R. I.

From 10 to 2000 Horse Power, with Harris's Improvements. These Engines are of

UNEXCELLED WORKMANSHIP,

and are known the world over as the

MOST ECONOMICAL STEAM ENGINE BUILT.

Electric Light Companies Take Notice! They are especially adapted for all purposes where continuous service at uniform speed is required and at the minimum of cost of repairs.

Send for a copy of Engineers, and Steam Users, Manual by J. W. Hill, M. E. Price, $1.25.

MITCHELL, VANCE & CO.,

GAS FIXTURE MANUFACTURERS,

Have added a department for the Manufacture of Electroliers and other fixtures adaptable to any system of Incandescent Electric Lighting, also Combination Fixtures for both Gas and Electric Light. Estimates and designs furnished upon application.

836 & 838 BROADWAY,

NEW YORK.

MANUFACTURER OF SUPERIOR

Carbon Points

$15. $15. $15.

Plates

BUFFALO ELECTRIC WORKS

A splendid carbon for summer lighting that will last from 6 to 8 hours, for $15.00 a thousand. Write to us for prices and samples, giving the system used, before making any contract for carbons at any price.

1590 to 1620 Niagara Street,

BUFFALO, N. Y.

I. W. COLBURN & CO. MFG'S OF

Dynamo Electric Machines

181 MAIN ST. Fitchburg, MASS. SEND FOR CATALOGUE

VICTOR BISHOP & CO.,

IMPORTERS OF DIAMONDS,

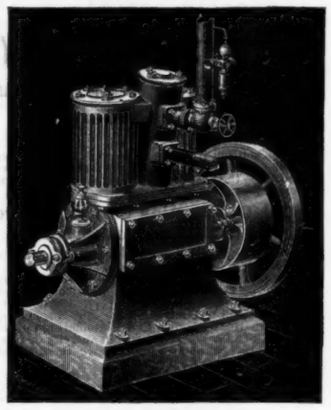
DEUM COLE REGEM SERVA

PLATINUM

For all Manufacturing, Chemical, Electrical, Dental, and Laboratory purposes.

Victor Bishop & Co.,

ESTABLISHED 1837. No. 33 MAIDEN LANE, NEW YORK.



Rear view, showing one wheel removed.

The Westinghouse Automatic Engine.

4 to 400 H. P.

900 ENGINES

AND 24,000 H. P. NOW RUNNING

SALES,

2,000 H. P. PER MONTH.

SEND FOR ILLUSTRATED CIRCULAR AND REFERENCE LIST.

The Westinghouse Machine Company,

Pittsburgh, Pa.

SALESROOMS,

94 Liberty Street, New York.
401 College Street, Charlotte, N. C.
401 Elm Street, Dallas, Texas.
53 South Market St., Nashville, Tenn.

Also, Fairbanks, Morse & Co., Chicago, Cleveland, Cincinnati, Louisville and St. Paul.

Fairbanks & Co., St. Louis, Indianapolis, and Denver.

"OTTO" GAS ENGINE

OVER 10,000 IN USE.

Started Instantly by a Match.

When Stopped all Expense Ceases.

Works without boiler, steam, coal, ashes or attendance. Successfully adapted instead of steam power in all industries and offers special advantages for running electrical machinery for Telegraph and Telephone as well as Lighting purposes.

Built in Sizes of 1, 2, 4, 7, 10, 15 & 25 Ind. H. P.

SCHLEICHER, SCHUMM & CO.

N. E. cor. 33d & Walnut, Phila.

Branch Office: 214 Randolph Street, Chicago.

PHOSPHOR-BRONZE

TELEPHONE WIRE,

Insulated and Bare.

"Phosphor-Bronze."

Combines High Electrical Conductivity and Resistance to Corrosion with Lightness and Tenacity.

Standard Sizes, 16, 17, and 18, Stubs' Gauge.

ADDRESS;

The Phosphor-Bronze Smelting Co. (limited,)

512 ARCH ST., PHILADELPHIA, PA.

Owners - of - the - United - States - Phosphor-Bronze - Patents.

Sole Manufacturers of Phosphor-Bronze in the United States.

WHITE OAK PINS AND BRACKETS,

Of Our Own Manufacture.

Correspondence and Inspection solicited.

DETROIT ELECTRICAL CO.

Cor. Seventh & Woodbridge Sts.,

DETROIT, MICH.

A NEW AND SUBSTANTIAL

BUSINESS INDUSTRY.

Large Profits to First-class Business Men.

The Thomson-Houston Arc and Incandescent System of Electric Lighting is universally acknowledged to be the most perfect and economical ever invented.

Local Companies cannot afford to use any other.

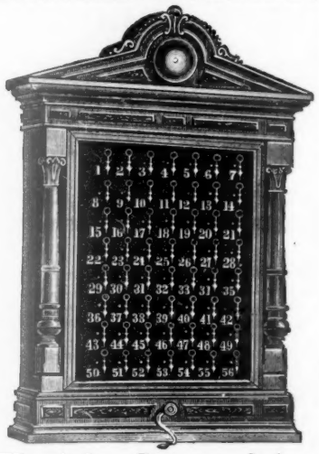
Companies now using this system are making large profits on their investments.

Complete Central Lighting Stations for City and Commercial Lighting, with Boilers, Injectors, Heaters, Armington & Sims' high-speed Engines and Wire lines, will be contracted for and constructed by the American Electric and Illuminating Co., 197 Congress Street, Boston, Mass., in any city or town in the United States where exclusive territory has not already been ceded.

To active and responsible business men, who can command a portion of the necessary capital to build central stations and secure business for same, this Company will furnish the remaining capital upon liberal terms. Address

EDWARD H. GOFF, President.

PARTRICK & CARTER'S



Electric Annunciator.

(PATENTED FEB. 16, 1875.)

We guarantee our Annunciator to be the most SIMPLE, durable and reliable apparatus in the market. NO DROPS or other COMPLICATED MECHANISM to get out of order, and NECESSITATING CONSTANT REPAIRS. We have furnished some of the largest and finest hotels in the country with our Annunciators.

Those wishing Agencies for these Annunciators in unlicensed territory can obtain all information, prices, etc., by addressing us.

Correspondence solicited with all Operators, Managers of Telephone Exchanges and Electric Bell-hangers. Send for Catalogue of Annunciators, Alarms, Electric Bells, etc.

PARTRICK & CARTER, 114 SOUTH 2d ST., PHILADELPHIA, PA.

American Electrical Works

MANUFACTURERS OF

Patent Finished Insulated

Electric Wires,

TELEPHONE AND ELECTRIC CORDAGE,

ELECTRIC LIGHT WIRE

MAGNET WIRE,

PATENT RUBBER COVERED WIRE, OFFICE AND ANNUNCIATOR WIRE, LEAD-ENCASED WIRE ANTI-INDUCTION AERIAL AND UNDERGROUND CABLES ETC., ETC.

OFFICE AND FACTORY:

No. 67 STEWART STREET,

PROVIDENCE, R. I.

EUGENE F. PHILLIPS, President.

W. H. SAWYER, Secretary and Electrician.

SPIRAL

TELEPHONE

WIRE.

For Long & Short Distance Telephoning

Patents allowed April 24, July 25, 1883.

American Spiral

Telephone Wire Company,

43 Milk Street,

BOSTON, MASS

THE

Law Battery.

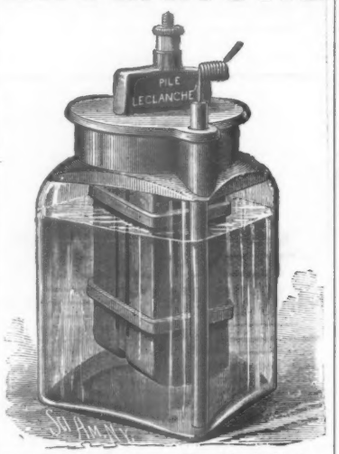
The BEST Open Circuit Battery in the World and the CHEAPEST.

Combines all the advantages of the best of the others, without any of their disadvantages. Thousands sold monthly. Send for circular. Manufactured and sold by the

LAW TELEGRAPH CO.,

140 Fulton St., New York.

LECLANCHE



Prism Battery, Complete. Size of Jar, 6x4½ inches.

THE GREAT

TELEPHONE BATTERY.

The Standard Open Circuit Battery of the World.

OVER 500,000 CELLS NOW IN USE IN THE UNITED STATES AND 1,000,000 IN EUROPE.

ADOPTED BY ALL THE

Telephone Companies.

THE SIMPLEST, CLEANEST, MOST DURABLE, MOST ECONOMICAL.

Beware of Infringements and Cheap Imitations.

LECLANCHÉ BATTERY CO.

149 W. 18th St., N. Y., or

L. G. TILLOTSON & CO., 5 & 7 Dey St., N. Y.

THE BERGMANN & HAID BATTERY.

The Greatest Open Circuit Battery in the World.

Superior to the Leclanche and all others, for Telephone, Annunciator, Burglar Alarm, and all open circuit work.

Price (complete) $1.20.

Liberal discount to dealers.

Send for descriptive Circular and Price List.

BERGMANN & CO.

Electrical Works,

292, 294, 296 & 298 AVENUE B,

NEW YORK, N. Y.

PAT'D {Oct. 16, 1883. Nov. 20, 1883.

CORNELL UNIVERSITY.

COURSES IN

Electrical Engineering, Mechanical Engineering, Civil Engineering, and Architecture.

Entrance Examinations Begin at 9 A.M., June 16 and Sept. 16, 1884.

For the UNIVERSITY REGISTER, containing full statements regarding requirements for admission, courses of study, degrees, honors, expenses, free scholarships, etc., and for special information, apply to THE TREASURER OF CORNELL UNIVERSITY, Ithaca, N. Y.

C. H. MOORE & CO.,

SOLICITORS OF

American and Foreign Patents,

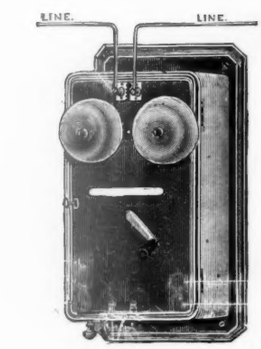
ELECTRICAL APPLIANCES A SPECIALTY.

Interferences, Appeals, and all business before the office and the courts given prompt attention. Address Lock Box 490, Washington, D. C.

Bargains in IMPORTED scientific and Experimental Apparatus, GEISLER TUBES, MOTORS, COILS, LANTERNS, &c., &c., Carbons for all kinds of Electric Light.

F. E. KINSMAN & CO.

145 Broadway, - New York.



Viaduct Manufacturing Co.

OF BALTIMORE.

(Successors to late firm of DAVIS & WATTS.)

A. G. DAVIS, President.

ELECTRICAL GOODS OF EVERY DESCRIPTION.

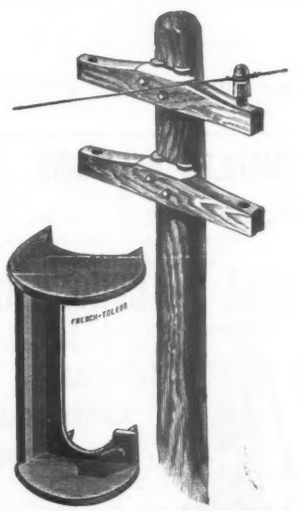
Telephone, Telegraph, Electric Light and American District Supplies.

SEND FOR ILLUSTRATED CATALOGUE,

MAGNETO SIGNAL BELLS.

NO BATTERY REQUIRED.

$4, to $6, each. Discount on large lots.



PATENT PORTABLE & ADJUSTABLE CROSS ARM HOLDER.

No more weakening of poles by cutting gains or mortising. Can be attached to any pole and changed when desired. Hundreds of these Holders now in use.

Recommended by practicable line builders. For information and circulars, apply to

WM. KLINE, Supt. Teleg.,

TOLEDO, O.

THE ELECTRIC STORAGE AND LIGHT CO.

95 Milk St., Boston, Mass.

Organized under the Laws of Massachusetts,

OWN THE PATENTS FOR

Faure's Storage Batteries,

OR

Electrical Energy Accumulators,

FOR

MASSACHUSETTS, RHODE ISLAND AND CONNECTICUT

JUST OUT.

Electricity, Magnetism AND Electric Telegraphy.

A Practical Guide for Students, Operators and Inspectors,

BY

THOMAS D. LOCKWOOD,

PRICE, $2.50

379 PAGES, WITH 150 ILLUSTRATIONS.

D. VAN NOSTRAND, Publisher,

23 Murray and 27 Warren Sts., N. Y.

Complete Catalogue of Electrical Works will be sent to any address on application.

THE FREEMAN & ROE ELECTRICAL SUPPLY CO.,

53 Broadway, N.Y.

DEALERS IN

Electric Motors, Dynamos and Electric Light Machines,

TELEGRAPH and TELEPHONE APPLIANCES

OF EVERY DESCRIPTION,

Learners Instruments & Alarms

Sole Agents for

The "Excelsior" Electric Call Bell, - $1.75

The "Toy" Telephone, 1.00

The Freeman & Roe Hotel Annunciator.

Furnish Estimates for and promptly execute all Electric Work for Architects, etc. Send for Circulars. Correspondence solicited.

THE TRENTON IRON CO.,

MANUFACTURERS OF

Galvanized Wire

OF VARIOUS GRADES FOR

TELEGRAPH AND TELEPHONE LINES.

WORKS AND OFFICE AT

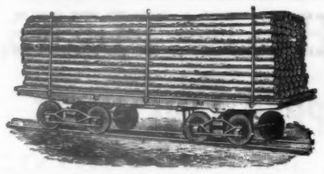
TRENTON, NEW JERSEY.

NEW YORK OFFICE:

COOPER, HEWITT & CO., 17 Burling Slip.

PHILADELPHIA OFFICE:

21 NORTH FOURTH STREET.



BROWNLEE & CO.

DETROIT, MICH.

DEALERS IN

Cedar Telegraph Poles,

MANUFACTURERS OF

Cross Arms, Pins and Brackets,

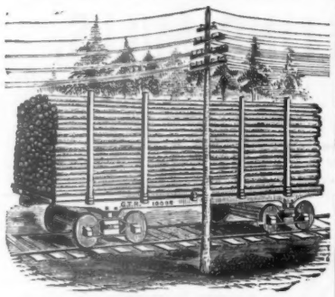
OAK and LOCUST PINS.

SEND FOR PRICE LIST.

☞ We defy competition in price or quality. ☜

Please mention this paper.

HANDSOME **POLES** & DURABLE.



CANADIAN CEDAR POLES, the best in use; live 25 to 35 years; good appearance. Prompt delivery at Buffalo, Black Rock or Suspension Bridge, N.Y. Cheap for spot Cash. Address.

HARVEY STAFFORD & CO.,

ACTON, Ont., Canada.

ROYCE & MAREAN,

DEALERS IN

ELECTRICAL APPARATUS,

Telegraph and Telephone Supplies,

No. 1408 Penna. Avenue,

Opp. Willard's Hotel, **WASHINGTON, D. C.**

Correspondence Solicited.

National Electric Company,

ELECTRICAL SUPPLIES AND APPARATUS,

1413 G STREET, WASHINGTON, D. C.

Estimates furnished. Correspondence solicited.

W. R. POPE & CO.

Corner North & Lexington Streets,

BALTIMORE, MD.

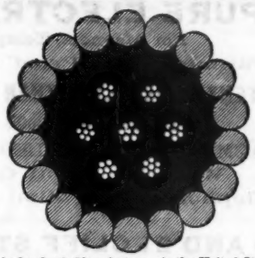
Telegraph, Telephone and Electric Light Supplies.

THE BEST OF EVERYTHING

AND AT LOWEST PRICES

The Bishop Gutta-Percha WORKS.

SAMUEL BOARDMAN, Agent.)



Original and only Manufacturers in the United States.

GUTTA-PERCHA INSULATED

Submarine Telegraph Cables,

50 Regular Sizes. One to Ten Conductors.

Subterranean Telegraph Cables,

Hempen-Armored Covered.

Aerial Telegraph Cables,

Lead or Hempen Covered.

ANTI-INDUCTION

Telephone (Lead-Covered) Cables,

as used by the Metropolitan Telephone & Telegraph Co.

Torpedo Cables,

Recommended by the European and South American Governments.

Lead-Covered Cables,

For Canal and Streamlet Crossings.

Gutta-Percha Office Wire, Leading and Connecting Wire,

For Subaqueous Mining and all other Electrical purposes.

Mark 1 Compound Insulated Wire,

For Office, Outdoor, Underground, and Battery Use.

G. P. Office Wire, Cotton-Covered.

ALSO HAVE ALWAYS ON HAND:

Wires of every variety of Insulation,

Magnet Wire, Telephone Flexible Cords, Flexible Elevator Cables, Electric Cordage, Burglar-Alarm and Annunciator Wire, Electric Light Wire, Cordage and Cables, Lead-Covered Wire, and every description of pure Gutta-Percha goods, Gutta-Percha Sheet, for Cable Splices; G. P. Chemical Vessels for Acids, etc.

Agents for Reception of Orders and Sale of Goods:

L. G. TILLOTSON & CO., 5 & 7 Dey St., New York.

WILLIAM HEATON, 503 Chestnut St., Phila.

Thirty-three years' experience has taught us that neither the electrical nor mechanical qualities of either Gutta-Percha or Copper deteriorate by long working or submersion, consequently the best form of a Submarine Telegraph cable will be that in which these conditions were fulfilled.—*Extract from Report on Cables, by Willoughby Smith.*

MANUFACTURED BY

The Bishop Gutta-Percha Works.

Address all communications to

W. W. MARKS, Superintendent,

420, 422, 424 & 426 East 25th St., N. Y.

OFFICE AT THE WORKS.

J. H. LONGSTREET,

9 Barclay St., New York,

Manufacturer and Dealer in

TELEGRAPH INSTRUMENTS

Telephone and Telegraph Supplies

—OF EVERY DESCRIPTION.—

ANNUNCIATORS and BURGLAR ALARM APPARATUS, BATTERIES and BATTERY MATERIAL.

Telegraph Instruments for Railroad Use a Specialty.

THE

NATIONAL LETTER CABINET FILE,

Patented and Manufactured by

O. C. MACKENZIE,

Successor to CULVER, PAGE, HOYNE & CO.,

186 and 188 Fifth Avenue, - Chicago.

320 and 322 Broadway, - New York.

SEND FOR ILLUSTRATED CATALOGUE.

TESTIMONIALS.

We are much pleased with your letter file and can recommend it as a very useful article.

SEMON, BACHE & CO., NEW YORK.

We do not hesitate to say it is *the best Cabinet Letter File made*, and can recommend the same to any and all business houses. It is the "boss."

GEO. D. BARNARD & CO., ST. LOUIS, Mo.

S. W. FRENCH, President. W. C. DEWEY, Treasurer. FRANK F. BULLARD, Gen'l Manager.

PALMER WIRE COMPANY

PALMER, MASSACHUSETTS.

Galvanized IRON

AND STEEL, AND

HARD-DRAWN COPPER Telegraph AND Telephone Wire.

UNSURPASSED IN

QUALITY of MATERIAL, FINISH and CONDUCTIVITY.

THE GALVANIZED IRON AND STEEL WIRE MANUFACTURED BY THIS COMPANY HAS ACHIEVED FOR ITSELF AN ENVIABLE REPUTATION FOR EXCELLENCE AMONG TELEPHONE AND TELEGRAPH COMPANIES WHO ARE USING IT EXTENSIVELY, AND BY WHOM IT IS UNIVERSALLY APPROVED. WE ARE NOW PREPARED TO SUPPLY **HARD-DRAWN COPPER WIRE** MADE FROM THE BEST LAKE SUPERIOR COPPER WITHOUT ALLOY BY A PROCESS LATELY DISCOVERED WHICH WE CONTROL. THIS WIRE IS THE EQUAL, IF NOT THE SUPERIOR OF ANYTHING IN THE MARKET. ORDERS, PROMPTLY AND CAREFULLY ATTENDED TO. SEND FOR QUOTATIONS.

NEW YORK OFFICE, - 15 COURTLANDT ST.

FRANK B. KNIGHT, GENERAL AGENT.

The Thomson-Houston Electric Company,

SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

—OF—

Electric Lighting in the World.

ALL OUR PATRONS TESTIFY THAT THE BEST IS THE CHEAPEST.

Owing to the Automatic and Self-Regulating features of this Apparatus—broad and valid patents for which are owned by this Company—sufficient saving is effected in power, attendance, and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

LOCAL LIGHTING COMPANIES CANNOT AFFORD TO OPERATE ANY OTHER SYSTEM.

We are prepared to supply Local Companies, Mills, Railroads, etc., with dynamos running from **one to sixty lights** each, and the largest machine is so perfectly controlled by its Automatic Regulator that it runs safely and economically at full speed with any number of lights below its maximum.

We furnish Arc Lights of various degrees of illuminating capacity, from 1,200 to 4,000 candle power.

We would call especial attention to our New Self-Regulating Divided Arc, which is a novel and valuable feature in our system, and for which there is a very large demand. It is the only practicable and perfect-working Small Arc yet offered to the public, and will effect a great reduction in the cost of Arc-Lighting plants, and very great increase in the efficiency and profits of local companies.

We have established between thirty and forty local companies during the past year, and many more are being organized.

We request capitalists who contemplate putting in an Electric Light Plant to confer with either the Boston or Chicago office before adopting any other system.

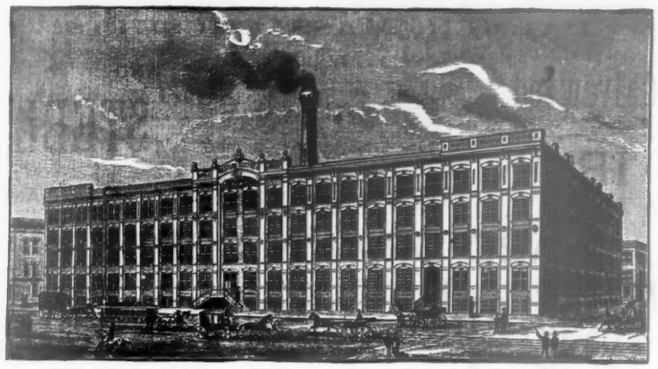
Correspondence with active, energetic men, capable of interesting capital and organizing local companies, is solicited.

New illustrated Pamphlet, Price-List, etc., will be furnished on application. Address,

THE THOMSON-HOUSTON ELECTRIC CO.,

131 DEVONSHIRE STREET, BOSTON, MASS.

Western Electric Company.



(Chicago Factory, 227 to 251 South Clinton Street.)

MANUFACTURERS OF

TELEGRAPH and TELEPHONE APPARATUS

AND SUPPLIES OF EVERY DESCRIPTION.

Hotel and House Annunciators, Burglar Alarms and Call Bells,
Electro-Mercurial Fire Alarm, Electric Gas-Lighting Apparatus,
Magneto Call Bells, Telephone Exchange Switch Boards, etc.

UNDERGROUND AND AERIAL CABLES.

Correspondence Solicited.

CHICAGO, BOSTON, NEW YORK.

A. G. DAY

MANUFACTURER OF
KERITE INSULATED TELEGRAPH & TELEPHONE

WIRE & CABLES,

OFFICE, 120 BROADWAY, N. Y.—FACTORY, SEYMOUR, CONN.

Anti-Induction Kerite Telephone Cables.

Some of them Two Miles in Length, are in use in several cities, and are found to WORK PERFECTLY for that distance. EMINENT ELECTRICIANS and PRACTICAL TELEGRAPHISTS commend and recognize the Kerite Insulation as superior to all others. At the Centennial Exhibition at Philadelphia, Sir William Thomson, the eminent Electrician and Scientist, awarded to the KERITE INSULATED WIRE AND CABLES

A DIPLOMA

FOR "EXCELLENCE OF THE INSULATION AND DURABILITY OF THE INSULATOR."

GENERAL AGENT:

CLARK B. HOTCHKISS,—120 BROADWAY, NEW YORK.

THE BAXTER ELECTRIC LIGHT CO.

Is prepared to negotiate for New Plants, Complete.

THE BAXTER
IMPROVEMENT IN
ELECTRIC LAMPS
IS THE
Greatest Invention in Arc Lighting yet made.

Efficient, Reliable and More Economical than any other Lamp in the World, and can be applied to any System. SAVES FROM ONE-HALF TO THREE-QUARTERS THE COST OF CARBONS.

For terms for territory and cost of Baxter attachment, address:

THE BAXTER ELECTRIC LIGHT COMPANY,
MILLS BUILDING,
NEW YORK.

The Keystone Electric Co. of Philadelphia, Agents for Pennsylvania.

THE ANSONIA BRASS & COPPER CO.,

MANUFACTURERS OF
PURE ELECTRIC COPPER WIRE,
For Magnets, Telephones, Electric Light, &c.,
Patented Fire-Proof Electric Light Line Wire,
PATENTED FIRE & WEATHER PROOF ELECTRIC LIGHT LINE WIRE,
Patented Paragon Line Wire—Fire Proof, Water Proof,
"ACME" BRONZE TELEGRAPH AND TELEPHONE WIRE,
Wrought Metal Gongs for Annunciators,
Telephones, &c., Zinc Rods, Battery Copper, &c.,
WAREROOMS:
19 AND 21 CLIFF STREET, NEW YORK CITY.
Factories, Ansonia, Conn.

HOLMES, BOOTH & HAYDENS,

MANUFACTURERS OF
HARD DRAWN COPPER LINE WIRE
FOR TELEGRAPH and TELEPHONE.
ELECTRIC LIGHT WIRE,
Magnet Wire, Patent "K K" Copper and Iron Wire,
Red and White Iron Line Wire.
NEW YORK, BOSTON AND PHILADELPHIA.
FACTORIES, WATERBURY, CONN.

BRIDGEPORT BRASS CO.,

BRIDGEPORT, CONN.,
INCORPORATED 1865.
BRASS, COPPER AND GERMAN SILVER
WIRE AND ROLLING MILLS,
Bare and Insulated Copper Wire for Electric Conductors a specialty.
SOLE AGENTS FOR THE
BRIDGEPORT ELECTRIC MFG. CO.

ARMINGTON & SIMS ENGINE COMPANY
TRADE MARK
PROVIDENCE, R.I. U-S-A

AUTOMATIC
QUICK ACTING ENGINE.

SELLING AGENTS:
JARVIS ENGINEERING CO., 61 Oliver St., Boston.
POND ENGINEERING CO., St. Louis, Mo.
J. F. RANDALL, Warren, Ohio.
JOHN R. MARKLE, Detroit, Mich.
H. B. SMITH MACHINE CO., 925 Market St., Phil. Pa.
T. W. ANDERSON, Houston, Texas.
MIJNSSEN & CO., Amsterdam, Holland.

M. F. MOORE, Gen. Agt.
15 CORTLANDT ST., NEW YORK.

THE ELECTRICAL SUPPLY CO.
MANUFACTURERS OF
Insulated Wire
OF EVERY DESCRIPTION.

(Factory of the Electrical Supply Co. at Ansonia, Pa.)

ELECTRIC LIGHT,
TELEPHONE AND
TELEGRAPH SUPPLIES.

Warehouse: 17 DEY ST., NEW YORK.

ALFRED F. MOORE,

MANUFACTURER OF
Insulated Wire,
—FOR—
Telephone, Telegraph and Electric Light,
OFFICE, LINE,
—AND—
ANNUNCIATOR WIRE,
Magnet Wire and Flexible Cordage,
200 & 202 N. THIRD ST.,
PHILADELPHIA, PA.